MACHINERY

Design—Construction—Operation

Volume 42 JANUARY, 1936 Number 5

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Brass Die-Casting—considered impractical only a few years ago because of the difficulties encountered with the high melting temperatures of copper base alloys—is now a commercial reality. One plant alone produces between 100,000 and 150,000 brass die-castings monthly. The leading article in February MACHINERY will explain the advantages of brass die-castings and will describe the so-called Polak method of producing them.

April MACHINERY — the Automotive Number — will feature high-production methods and processes.

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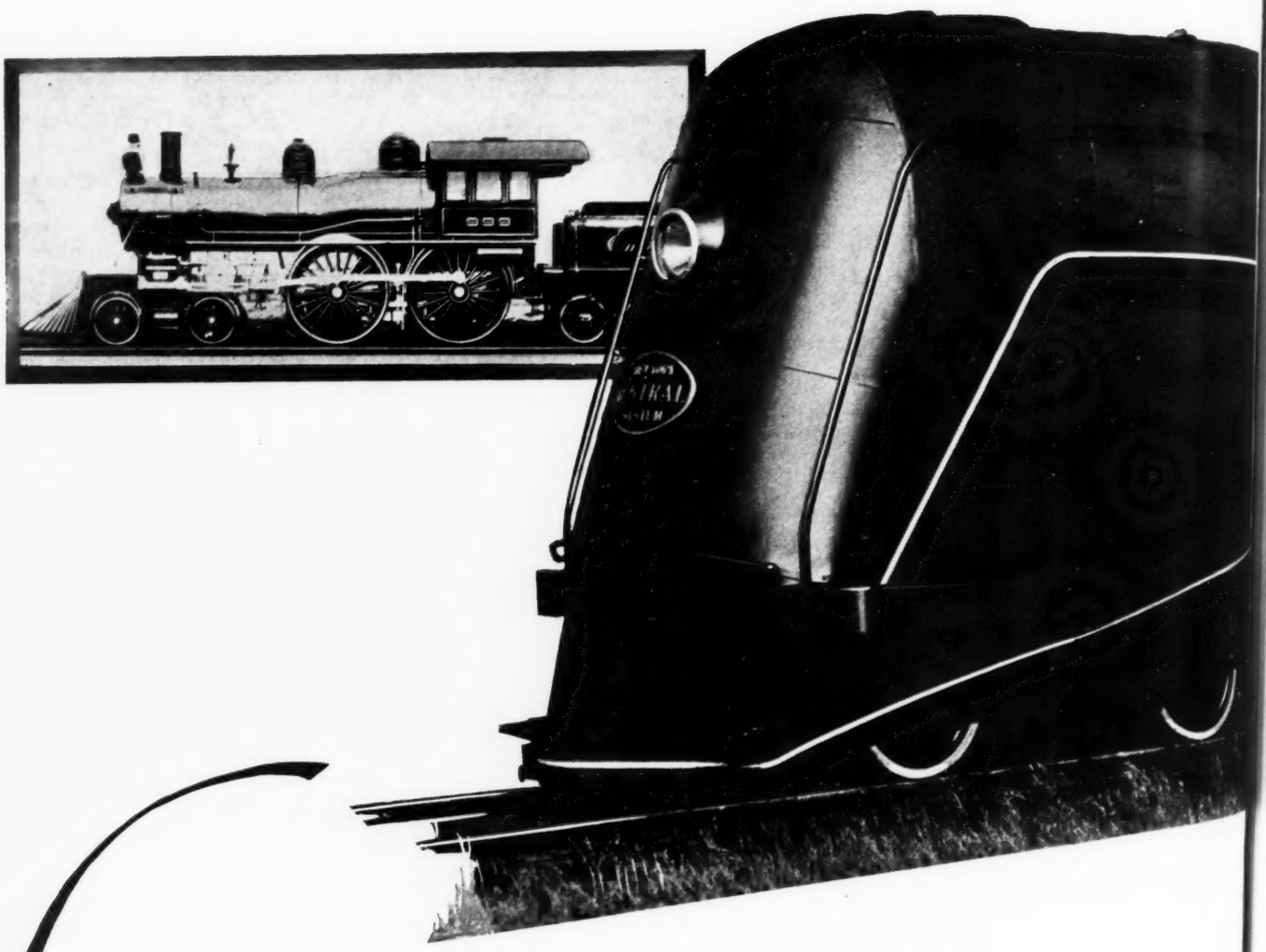


Contrasts

In 1893 the engine in the inset, the famous No. 999, was placed in operation on the tracks of the New York Central System. Compare it with the Commodore Vanderbilt, the last word in modern steam locomotives! Startling! Both in looks and performance.

Yet the progress here portrayed is no more vivid than the changes and improvements in lathes — the basic machine tools.

In 1893 The Lodge & Shipley Machine Tool Company turned out their first lathes. Each of the 43 years intervening between then and the present has seen steady progress—improvements in design and operation that mean constantly increased efficiency. Today's Lodge & Shipley Lathes are as far ahead of those first lathes of 1893, in both appearance and performance, as the Commodore Vanderbilt is ahead of its early predecessor.

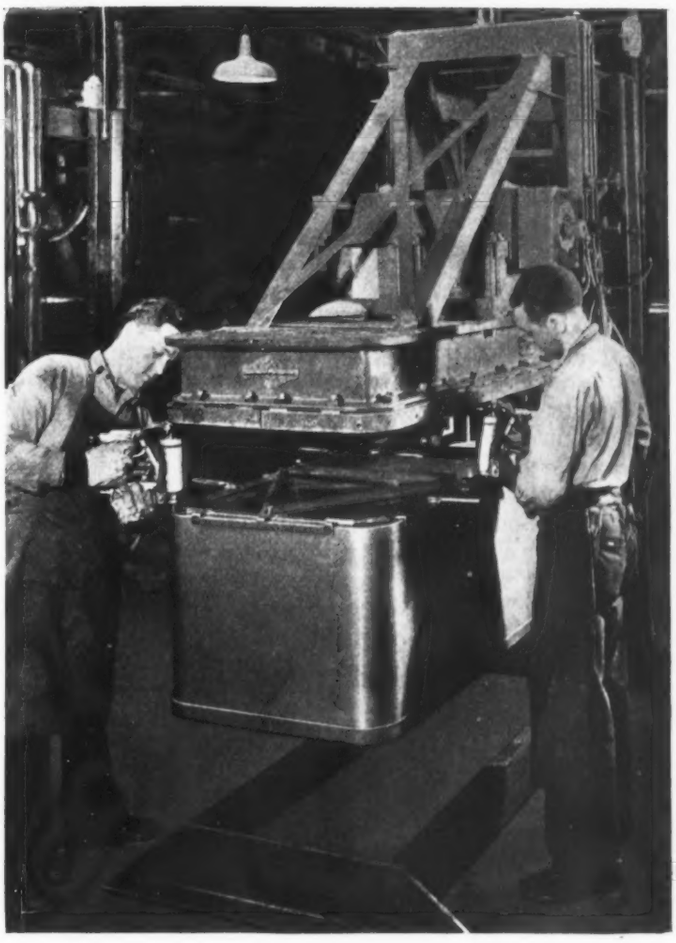
LODGE & SHIP

MACHINERY

Volume 42 NEW YORK, JANUARY, 1936 Number 5

When is Resistance Welding Applicable?

This Article Answers Three Questions: What Metals Can be Welded? For What Character of Work is Resistance Welding Suitable? What Production is Required to Make It Applicable?



By M. L. ECKMAN
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Thomson-Gibb Electric Welding Co.
Lynn, Mass.

RESISTANCE welding—that is, spot, projection, seam, flash, and butt welding—is essentially a method of assembly. It is primarily a production process rather than a jobbing shop or repair process. Nevertheless, there have been some far-sighted manufacturers who have applied resistance welding successfully to jobbing work.

The manufacturer who is contemplating the feasibility of applying resistance welding to his work is likely to ask three questions: (1) What metals can be welded? (2) What character of work lends itself to the resistance welding process? (3) How large a production is required to warrant the expense of installing welding equipment? The present article will endeavor to answer briefly these three questions.

The weldability of the common metals is no longer a serious problem. Today metals are welded with entire satisfaction in production work that ten years ago were considered impossible to weld. Iron and steel, including alloy steels and stainless steels, as well as copper, brass, bronze, nickel, Monel metal, and nickel silver, can all be satisfactorily welded. Coated materials, such as tin plate, terne plate, chromium-, cadmium-, and zinc-plated objects can all be welded with satisfaction, but most of the coating is generally burned off at the weld. The materials that present the greatest difficulty and that may be said to be more or less

"tricky" as regards welding are lead, tin, molybdenum, zinc, aluminum, and magnesium.

One of the obstacles to good welding is the oxide or scale that is on most materials in greater or less degree. At the low voltage used in the welding operation, oxide, being an excellent insulator, interferes with the flow of current. This does not mean that welds cannot be made where there is oxide, but it does mean that it is more difficult; and the greater the amount of oxide, the more trouble will be encountered.

The question has been asked: Why not use a flux to overcome the difficulties presented by oxide in resistance welding? No flux would react as rapidly as is required in one cycle, for example—one-sixtieth of a second—or even in forty cycles—two-thirds of a second. Furthermore, the body of the flux is likely to act as an insulator.

When is it Practicable to Apply Resistance Welding?

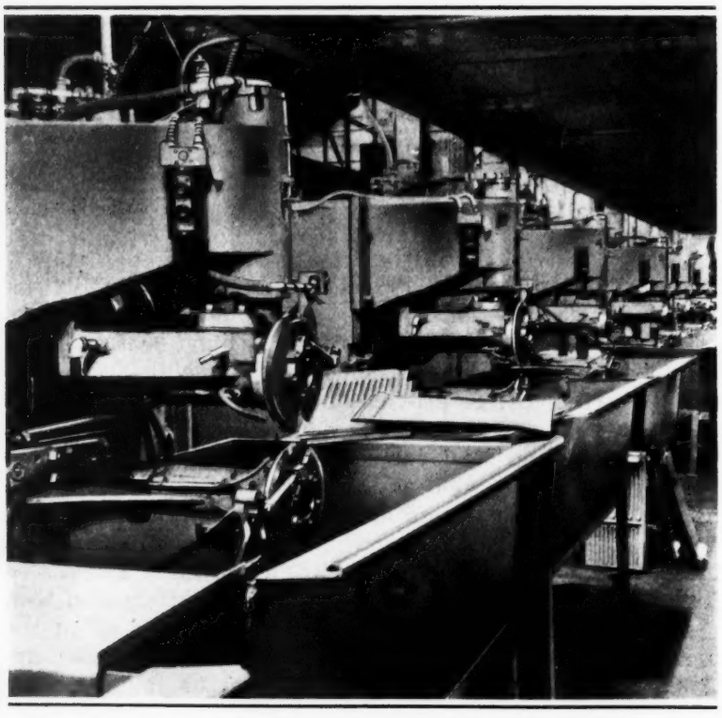
The answer to this question is a matter of experience. No hard and fast rule can be applied. The manufacturer who believes that he can use welding advantageously should first of all place his problem in the hands of a reliable welding machine manufacturer. In submitting such a problem, as much information as possible should be supplied. The more the engineers who are to suggest a solution know about the object to be welded—how it is to be used, in what quantity it is to be made, etc.—the more intelligent an answer are they able to give. It may be necessary to suggest changes in the design to facilitate resistance welding. It may be that all the tools for producing the part have been made and that a change in design would involve a great expense. Hence every fact pertaining to the manufacture and use of the article should be submitted in order that the welding problem can be properly analyzed.

It can be safely said that the majority of articles fabricated from sheets, channels, angles, tubing, forgings, or stampings—either in ferrous or non-ferrous metals—can be profitably welded if they are properly designed for welding. Perhaps the two most outstanding examples of welded products designed so that resistance welding can be used efficiently are the automobile and the modern refrigerator, whether gas or electrically operated, as well as the modern ice refrigerator.

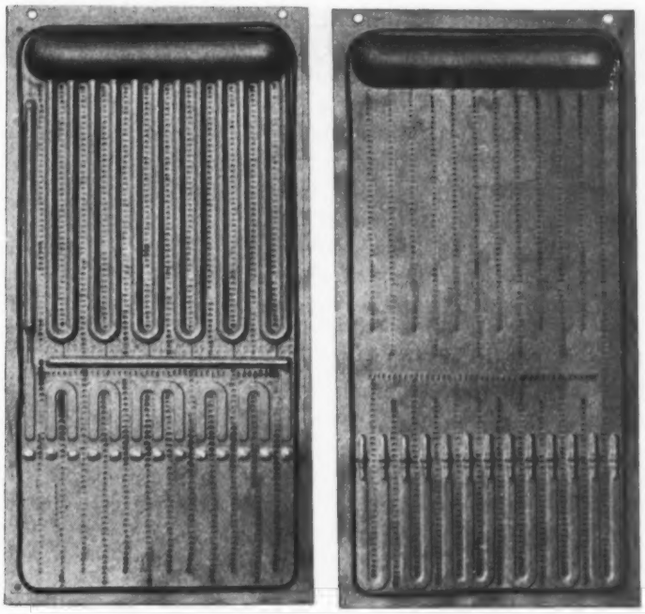
A most efficient radio tube is on the market today, in which the outer case, formerly made of glass, is now made entirely of steel. This tube is assembled almost wholly by resistance welding. There are about seventy-five welds on each tube.

How Large a Production is Required to Warrant the Installation of Welding Equipment?

In resistance welding, it is the initial cost and not the upkeep that is the important factor. The cost of current for operating resistance welding machines is extremely low, as compared to other assembling costs. The important point, therefore, to ascertain is whether the production warrants the initial expense of installation. Just to indicate how cheaply welds can be made, not counting the initial cost, the following figures may be of interest: 1000 spot welds on 16-gage metal can be made for 5 cents; 1000 linear feet of seam welding on 16-gage metal can be made for $2; 1000 flash welds



Seam-welders Used at the Schenectady Plant of the General Electric Co. for Welding Refrigerator Evaporator Parts. These Welders are Equipped with Thyratron Control



Pressure-tight Seam Welds, Intermittent Seam Welds, and Spot Welds are Made on Refrigerator Evaporator Parts

on one square inch area of stock can be made at a cost of 75 cents. These figures are based on a current cost of two cents per kilowatt-hour. The initial cost, of course, must be distributed over the life of the welding machine.

To answer the question whether there is enough production to warrant the initial expense requires obviously some accounting, and each individual case must be considered by itself. When there is quantity production, however, there is no question about the savings that can be made. The experience of the automobile and refrigerator industries are especially significant in this connection.

The leading automobile companies in this country and abroad have spent millions of dollars in the last fifteen years for resistance welding machines. It has been estimated that automobiles would cost from $75 to $200 apiece more today than they do, were it not for the economy introduced by the welding method. The body frame, gasoline system, rear-axle housing, and wheels are to a considerable extent assembled by resistance welding.

The modern refrigerator is almost entirely assembled by the welding method. The selling price of refrigerators would have to be increased from $35 to $75, depending upon the kind and size, were it not for the economies of resistance welding.

The time in which a welding machine should pay for itself varies with different users. Some of the automotive companies figure that a piece of new equipment should pay for itself in one year. In other lines of manufacture two or three years are allowed. This, of course, must be taken into consideration in distributing the initial cost over the total number of welds made. In nearly all cases where the job is adapted to welding and the quantity is sufficient, a substantial saving can be shown.

Spot welding, as the name indicates, is used for welding in spots overlapping sheet metal or articles made from sheet metal. It is utilized principally where ample physical strength is required, but where a pressure-tight joint is not necessary. Ninety-five per cent of all spot welding is made on stock from 12 to 24 gage; not more than 5 per cent is made on gage thicknesses heavier than 12 or thinner than 24; but stock 1 inch thick has been spot-welded, and so has stock as thin as 0.002 inch.

When and Where is Seam Welding Applied?

Seam welding is used for joining overlapping sheet metal to produce a pressure-tight joint or joints that will permit no lodging place for dust and dirt. It is generally used for gasoline tanks, refrigerators, milk cans, vacuum bottles, barrels, pails, and containers of various kinds. In this case, it may be said that about 95 per cent of the seam welding is done on stock of from 14 to 26 gage, while only about 5 per cent is done on thicknesses greater than 14 gage or thinner than 26 gage. Seam welding has, however, been performed on stock 3/8 inch thick and on stock only 0.002 inch thick. Generally it is considered that seam welding should not be used for metal heavier than 10 gage (about 0.140 inch).

Application of Projection Welding and Flash Welding

The projection welding method is generally used for attaching brackets to housings and for fabricating articles of varying thicknesses, such as auto-

mobile housings, radio cabinets, metal furniture, typewriters and bookkeeping machines, cash registers, toys, camping equipment, stoves, refrigerators, radio tubes, and a variety of other articles.

The projection welding method is practicable for almost any thickness of material, and is being applied so generally that it is difficult to pick up any assembled metal article today that has not to some extent been projection-welded.

In projection welding, the size of the projections raised on the pieces to be welded should be in proportion to the thickness of the material. It is also important to see that the welding machine has ample capacity to handle the job. No rule can be laid down for this, as the thickness of the stock, the throat depth of the machine, the number of projections, and the area over which they are spaced has an effect on the capacity of the machine. Projection welding is also used to make a number of spot welds simultaneously, such as thirty-two spots along the bracing of an automobile hood.

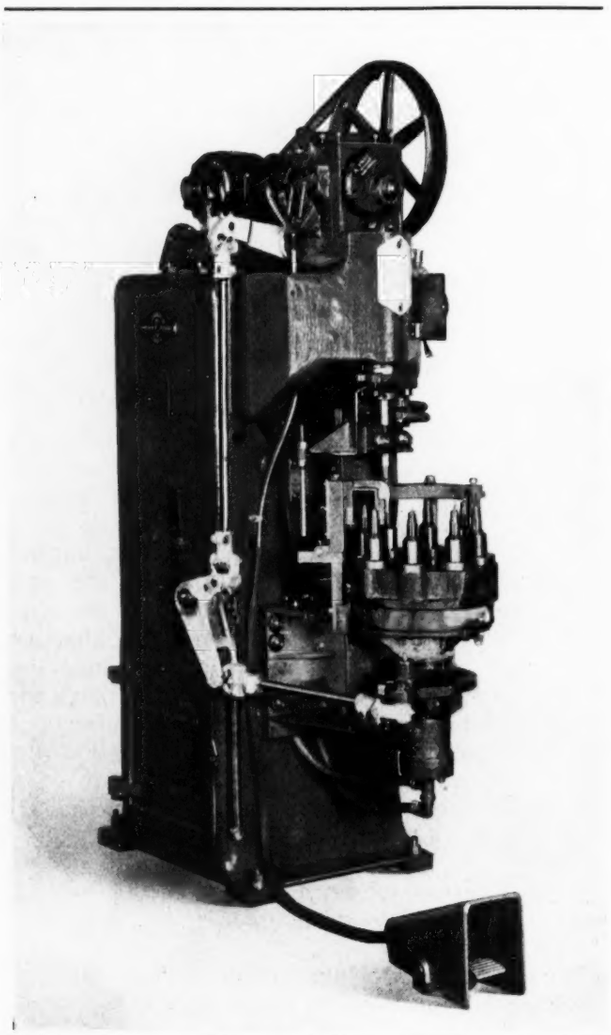
Flash welding is used for joining materials that cannot overlap, as, for example, when flanges are joined to tubular members, forgings to shafts, formed sheet-metal automobile bodies to adjoining members, etc. In flash welding, the parts are "butted" together end to end. A properly made weld has all the strength and quality of a one-piece article. Ninety-five per cent of all flash welding is done on parts of 3 square inches or less in area. The largest flash weld ever made, as far as the writer knows, involved 50 square inches of metal. On the other hand, many parts that are only from 0.010 to 0.050 inch in diameter are flash-welded.

The Wide Range of the Application of Resistance Welding

Probably the question as to when and where resistance welding is applicable cannot be answered in a better way than by referring to a number of applications in successful use today. Let us begin with an article with which we are all familiar—the fountain pen. Its iridium-platinum nib is seam-welded to the 18-karat gold pen point. Most rings adorning milady's fingers are flash-welded into a "perfect circle." Lodge emblems usually have the pin either spot- or projection-welded to the face. Typewriters are spot- and projection-welded in many places; so are cash registers, comptometers, mailing machines, duplicating machines, and all kinds of metal desks, filing cabinets, and furniture. On ice skates the tool-steel blade is spot-welded to the tubular frame; on roller skates, the toe- and heel-plate projections are welded to the frame; metal toys are almost all spot-, projection-, or seam-welded; steel-shaft golf clubs are flash-welded to the head; many bicycle frames are flash-welded.

Of things used in the home, most lamps are welded products, and even the tungsten filament in the electric-light bulb is flash-welded to the lead-in wires. Stainless steel knives are flash-welded to mild steel shanks, which, in turn, are embedded in synthetic plastic handles. The Monel metal sink is flash-welded, and the Monel or Everdur tank in the basement that supplies hot water to the house is seam- and spot-welded. The electric or gas range is assembled by welding. The stainless steel pots, pans, and trays are spot-welded in many places. The vacuum cleaner and the electric washing machine have their share of resistance welding. In the automatic refrigerator there are about 800 spot welds and 75 inches of seam welding, besides many projection welds.

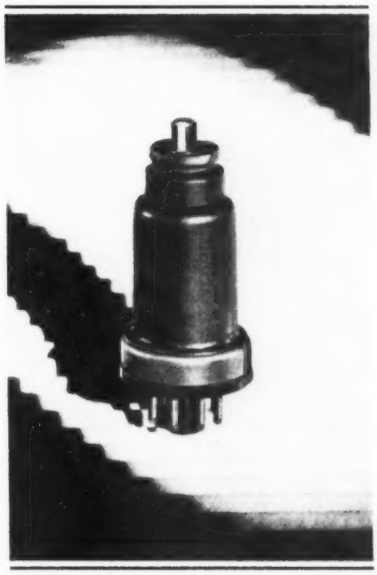
The toaster and the electric percolator are spot- and projection-welded. The radio assembly is welded in many places, and may have all-steel tubes. These tubes, one of which is shown on the opposite page, have seventy-five welds each.



Machine for Welding Radio Tubes — There are About Seventy-five Welds on Each Tube

The list is getting rather long, but let us include the garden tools, the rake and the shovel, and then let us examine some 1000 spot welds, 50 inches of seam weld, and about 30 flash welds in the automobile. Resistance welding is one of the contributing factors to the successful manufacture of the present all-steel safety body.

Last, but not least, let us mention such spectacular resistance welding as is used in streamline trains and in the airplane that Admiral Byrd used on his first trip to the pole which had sixteen resistance flash welds holding the engine to the frame and the landing gear to the plane. Much resistance welding is also used in military equipment and even Mussolini's tanks are fabricated by this method. Of the eighty-five different classes of machinery listed by the United States Census Bureau, sixty-five use resistance welding in their assembly.



Metal Radio Tube which is Almost Entirely Assembled by Resistance Welding

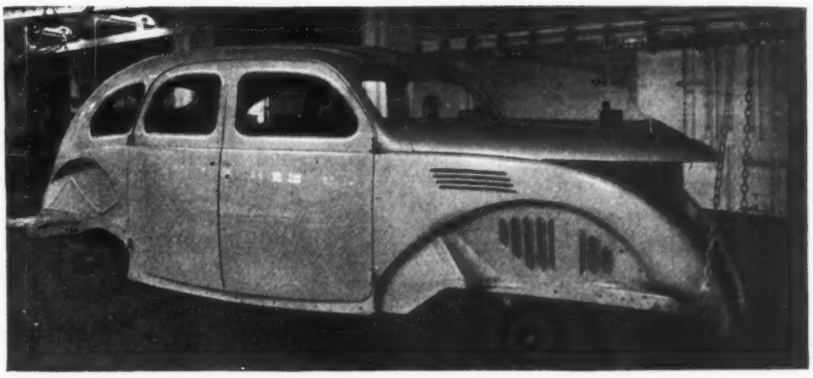
What is the Cost of Resistance Welding, Compared with Other Methods?

Most manufacturers do not care to have their cost figures revealed. Hence it is difficult to give conclusive figures relating to past performance. The following history of the growth of a concern that ascribes much of its success to resistance welding may, however, be of interest.

Some time ago, a small concern entered the highly competitive field of making tubular ice skates. The company started in a small way with equipment consisting of half a dozen blanking and forming presses, two furnaces, nickel-plating equipment, six polishing jacks, a lathe, a shaper, a milling machine, and last, but not least, a spot-welder. Very soon the company bought three more welders. In August there were more orders on this company's books for the Christmas trade than could be filled in time for Christmas. Some 2500 pairs of skates are made every day with unskilled labor, except for the diemakers; and perhaps the most remarkable of it all is that this business was built up during three years of the most severe business depression that this country has ever known.

The main object of this article has been to indicate the broad field for the application of resistance welding. It is believed that this object has been achieved.

A Striking Example of the Possibilities of Resistance Welding — Over 8000 Welds are Made in Fabricating the Body of the New Lincoln-Zephyr. This Automobile Has No Conventional Chassis, the Axle Assemblies and Engine Being Attached Directly to the Welded Body Structure



Common Causes of Gear Failures

Some of the Troubles Encountered with Heat-Treated Gears were Referred to by John T. Howat, of the Pittsburgh Steel Foundry Corporation, in the Paper Here Abstracted, which was Read before the Gear Manufacturers' Association

THE standards for gear materials which the American Gear Manufacturers' Association has drawn up from years of experience indicate that a steel containing from 0.30 to 0.40 per cent carbon for castings, and one containing from 0.40 to 0.50 per cent carbon for forgings, are most suitable for economical production. These two grades of steel can be given a wide range of physical properties by water quenching. Properly heat-treated, these steels have characteristics that meet most present-day service requirements. They have a high elastic limit, good fatigue and impact resistance, satisfactory elongation and reduction of area, high Brinell hardness, and great wear resistance.

Unfortunately, in the daily routine of heat-treating gears, the desired results are not always obtained, which may be due to conditions beyond the control of the heat-treater. Some of the causes are non-uniformity of the physical structure or grain size of the steel as it comes from the mill; irregularity in the chemical composition; and improper design for successful foundry or heat-treating methods. These conditions may cause failure of the gears either in the heat-treating department or in service. The failure in service may be due to breakage, rapid wear of the teeth, or distortion beyond the permissible tolerances.

Causes of Rapid Wear, Breakage, and Fatigue Failures

When the teeth wear rapidly, it is often because they are not hard enough. This would indicate insufficient time allowed for heating prior to quenching, or poor quenching due to the use of a quenching medium that was too hot.

When the teeth are broken off with a sharp break at the root, this usually indicates a low impact value in the steel, which is caused by too deep hardening or too low a drawing temperature. Dirty steel, either from inclusions or impurities, will also cause low ductility and impact values. This condition can generally be easily recognized under the microscope on examining a non-etched or etched sample of the steel.

The breakage of the ends of gear teeth is the result of excessive shrinkage, due to too severe quenching. This can be remedied by rounding both ends of the face to at least a 1/8-inch radius or by more carefully timing the quenching of the gear.

The characteristic fatigue failure which starts as a slowly progressive crack from the corners of the teeth at the root and travels downward to the center line of the teeth clearly indicates an overloading of the material beyond its fatigue limit. If the usual smooth surface of the break has fine holes or pin points, an examination of the microstructure will reveal a badly contaminated or dirty steel. These impurities lower the tensile and fatigue properties of the steel far below what might be expected of it. They may cause, on quenching, incipient cracks in the steel, which will result in failure under normal loading conditions in service.

If the material is free from inclusions and the heat-treatment has been properly done, then fatigue failure is purely a case of overloading; and if the load cannot be reduced, an alloy steel must be used to raise the fatigue limit high enough to take care of the service conditions.

When gears crack through the web, rim, hub, bore, or junction of the arm with the rim or hub, the cause is usually a defect in the material. If the gear is made from a casting, the fractured surface may show shrinkage, slag inclusion, or a chemical segregation. In forgings, there may be rolling seams or laps in the web of the gear or there may be a pipe or segregation in the hub, due to insufficient cropping of the ingot. Each of these defects may cause shrinkage strains from quenching beyond the elastic limit of the steel, so that an internal crack starts. This crack may cause failure in the heat-treating department or in service under comparatively low loads or vibrations.

Cracks in Hubs of Gears Due to Sharp Corners

Too sharp corners of keyways are responsible for most of the cracks that occur in hubs. All machined corners should be well rounded to remove the danger of starting a crack. If the fractured surface has a well defined break and the chemical analysis and hardness agree with the specifications, then the gear may have been over-stressed due to the quenching.

In many services where the tooth loads are high, the surface of the teeth at the pitch line will develop small circular or oval spalls. These may be very shallow and soon wear down, so that the sur-

face becomes satisfactory. These small spalls are the high points left as chatter marks by the cutters and have to stand the full tooth load until the whole face surface is in contact. This naturally results in local overloading; and as the surface metal is extremely hard, it will not deform easily to assume a full bearing of the face.

Unfortunately, in some cases, the spalls are too large and deep to wear down, so that the tooth form is destroyed and the gear or pinion must be replaced. This condition may also arise in hardened, ground, or lapped gears. In that case, the trouble is too coarse a structure, due to poor material or faulty heat-treatment.

Since fully 75 per cent of gear failures are directly or indirectly the result of quenching strains, it would appear that this factor in the heat-treating process should be given particular care. The fact that a 0.15 to 0.25 per cent carbon steel gear, carburized and water quenched, having a tensile strength of 35,000 to 40,000 pounds per square inch will make a satisfactory gear for many installations, indicates that the teeth only need be hardened, while the rest of the gear may be left soft. The setting up within the gear of quenching stresses that would cause its failure by cracking would thus be eliminated.

Difficulties with Pinions Made from Hot-Rolled Bars

Many pinions show the teeth uprooted across the full face of the pinion, taking a portion of the base material with them. The exposed fractured surface has a typical woody or fibrous structure running parallel with the face. The pinion blanks have been cut from a hot-rolled bar with no attempt to refine the grain by forging or annealing, the result being that the original elongated structure is present, even after heat-treatment.

Commercial hot-rolled bars are often rolled at too high a temperature due to high-speed production, or a breakdown in the mill may have caused the over-soaking of the billets in the heating furnace, with the result that a large grain size is produced which is extremely difficult to break up with annealing or quenching.

Pinions that are to be used in highly stressed service or that are to be heat-treated should be well annealed and obtained from a reliable source of supply. It is best to use forged bars or upset pinion blanks. Uneven heating, the working of a billet during forging, or uneven cooling after forging will leave an unbalanced structure in the finished raw material.

Some Difficulties with Steel Used for Gears

When two or more heats of steel with widely varying combined amounts of carbon and manganese or alloy content are supplied on one order, and the respective blanks from each heat are not kept separate during the processing through the shop, there is a possibility of trouble in heat-treatment. If the difference in analyses between the heats is not too great, a mean quenching temperature may be used and the pinions separated by their Brinell hardness values and drawn accordingly, at different temperatures; but the best method to safeguard against difficulties is to ask for a "close" analysis where multiple heats have to be used.

Occasionally pinions of from 0.40 to 0.50 per cent carbon steel will register a Brinell hardness of only from 300 to 350 after water quenching, whereas it should be around 445 to 510. The pinions may be low in hardness on the outside diameter, but register the proper hardness in the center of the teeth at their roots. In such a case, it may be assumed that the blanks were made from rolled or forged bar material and that insufficient stock was allowed on the original outside diameter for the complete removal of the decarburized surface metal.

If the pinion is soft all over, then the blank or bar of steel from which the pinion was made has been overheated at some time and cannot be recovered by any heat-treating process other than remelting it into new steel.

In castings for gears, an excess of a poor grade of foundry scrap used in making up the charge is often the cause of trouble. The charge should be so balanced that a maximum of 55 per cent of old foundry scrap is never exceeded, and a sufficient amount of good scrap and pig iron should be used. Like overheated forged steel, a poor casting must be remelted, as no form of heat-treatment will make it suitable for gears.

Precautions in Using Alloy Steels for Gears

When a carbon steel gear, hardened to its maximum safe hardness limit, will not produce physical values high enough to meet a specific service condition, or when the design of the gear will not permit of water quenching, then we must resort to an alloy steel suitably heat-treated. Alloy steels, in their many combinations, will provide a wide range of physical properties when heat-treated. Sufficient time must always be allowed in all heat-treating operations on alloy steels. If the time element is not observed, the same non-uniform results will be obtained as in carbon steels similarly mistreated. Many of the complaints that gears do not perform properly are due to the fact that not sufficient time has been taken for the heat-treatment; alloy steels must be even more carefully quenched and drawn than the plain carbon steels to obtain satisfactory results.

In a carbon steel to which has been added a small amount of alloy, a refined structure is obtainable. Having this fine grain to start with, the physical properties will be greatly improved by heat-treating. On water quenching these steels, the ratios of ductility to tensile strength and impact values are much higher than in the straight carbon steels.

These alloy steels should be normalized and drawn before any work is done on them, as the best results are obtained when heat-treating from the normalized and drawn condition.

Most failures of steels in this class are caused by cracking, due to temper brittleness or to deep quenching. This difficulty can be easily overcome by proper heat-treatment. When close tolerances are required, such as are needed in automotive and tractor gearing, the carbon range specified should be within from 3 to 5 points, and the other elements should also be within closer limits than are regularly used.

Precautions in Making Carburized Gears

Difficulties met with in gears and pinions made from 0.15 to 0.25 per cent carburized carbon steel may be due to the fact that the carburizing heating cycle is rushed too fast, so that there is a coarse grain at the line of demarkation where the case joins the core. Should the carburizing time be too long or the temperature too high, this coarse grain will be found throughout the case and core. This structure cannot be broken up satisfactorily, so that there will always be a brittle case, which accounts for the spalling of the case and corners of carburized gears and pinions under light impact blows in cases where the carburizing process has not been carefully carried out.

The proper control of the grain size of the material, combined with a long carburizing time at a lower temperature, is the best way to avoid this trouble. Soft spots may be the result of dirty carburizing material, allowing scale or dust to come in contact with the metal surface; or decarburizing metal may still have been left on the pinion, due to the fact that insufficient stock was allowed for machining the blank.

Pressed Metal Engineering and Die Design—A New College Course

Metal stamping is one of the principal industries of Toledo, Ohio, and that city is known also as the home of the largest pressed-metal machinery building plants in the world. It is especially fitting, therefore, that the University of Toledo should be the first college to offer a course devoted entirely to that industry. This course, which is called "Pressed Metal Engineering and Die Design," was started this fall for evening students with an initial registration of sixty-three men. The class is taught by E. V. Crane, who is on the engineering staff of the Toledo Machine & Tool Co. and of the E. W. Bliss Co.

The students taking this course will study the types of dies used for different classes of operations in shaping sheet metal, the ways in which metals are made to flow, the pressures required, possible economies in die construction, the use of automatic feeding mechanisms to obtain increased production and safety, methods of hot and cold forging, swaging, upsetting, extrusion, and other subjects of a kindred nature.

* * *

Age of Navy Yard Equipment

It has been estimated that the government navy yards and arsenals have machine tools and shop equipment with an original value of between $35,000,000 and $40,000,000, the average age of which is twenty-eight years. Here, it would appear, is an opportunity for rehabilitation of industrial equipment and a place where the Government might spend some of the billions appropriated for recovery purposes to real advantage.

Wooden pallets constructed of thin strips of inexpensive lumber are used in combination with a fork truck in a materials-handling system developed by the Elwell-Parker Electric Co., Cleveland, Ohio. The illustration shows a truck in use in a machine shop. Two pallets, each loaded with fifteen tote boxes of work, are about to be carried away from the machines by which the work was produced.

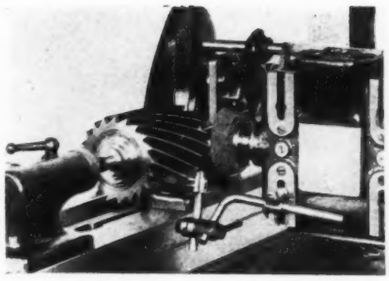


Fig. 1. Grinding a Spiral Milling Cutter

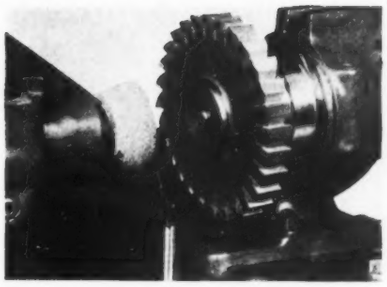


Fig. 2. Grinding Sides of Teeth on Side Milling Cutter

Fig. 3. Grinding the Face of an 18-inch Face Mill

The Grinding of Milling Cutters*

A Detailed Review of the Methods Used in Grinding Different Types of Milling Cutters with a View to Obtaining the Best Results in Milling Operations—Second of Two Articles

By A. H. PREY, Sales Research Department
The Carborundum Company, Niagara Falls, N. Y.

IN the first installment of this article, published in December MACHINERY, the general principles involved in the grinding of milling cutters were outlined. This installment will deal with specific methods of setting up different types of cutters for sharpening. These are typical set-ups that may be varied to suit conditions. In some cases, a cup-wheel is shown; in others, a plain wheel. Some prefer one, and some the other. No hard and fast rule can be given. As noted in the previous installment, a plain wheel may be swiveled, so that the amount of hollow grinding on the land will be reduced. In using a cup-wheel, the wheel-head should be set at an angle of about 1 degree from the zero position to provide clearance for the side of the wheel that is not grinding.

A spiral milling cutter, as shown in Fig. 1, should be mounted on an arbor supported by the footstock. The traverse movement may be obtained by moving the table or by sliding the cutter on the arbor. Stops should be used, so that the cutter will not run off the tooth-rest. If table traverse is used, the tooth-rest should be mounted on the wheel-head; if the cutter is moved on the arbor, the tooth-rest may be mounted on the table, but it must be in line with the wheel face.

On side milling cutters, the land should be about 3/64 inch wide. A clearance angle of about 6 degrees, with a secondary clearance of 12 degrees, should be used. The latter clearance should be as

*Abstracted from a forthcoming book on tool-room grinding to be published by The Carborundum Company, Niagara Falls, N. Y.

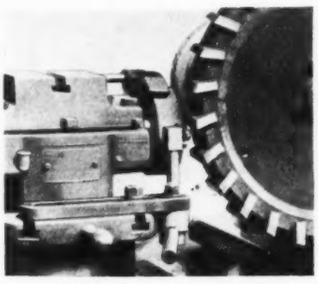


Fig. 4. Grinding Periphery of an 18-inch Face Mill

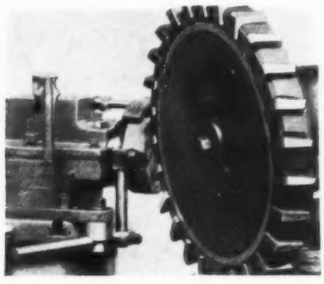


Fig. 5. Grinding Corners of Teeth of 18-inch Face Mill

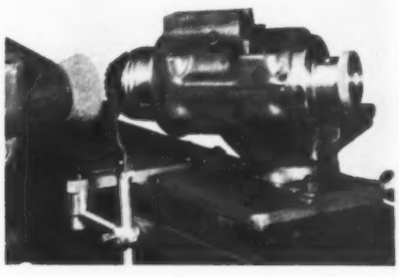


Fig. 6. Grinding the Teeth of an Angular Cutter

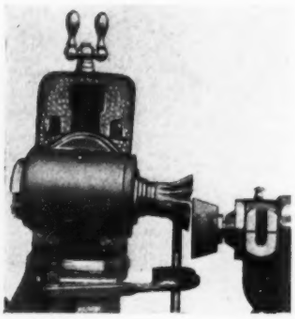
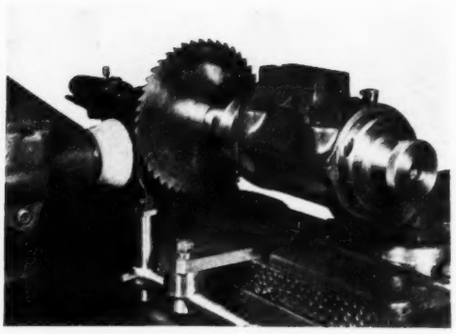


Fig. 7. (Left) Grinding the End Teeth of a Shank End-mill

Fig. 8. (Right) Set-up for Grinding the Teeth of a Saw



small as possible and yet prevent drag of the heel of the tooth on the work. The sides of the teeth are ground to the same specifications. The cutter should be slightly thinner at the inside edge of the tooth than at the outside.

The cutter is held on a stud mounted in the work-head spindle, which is swiveled to the required clearance angle. A typical set-up is shown in Fig. 2.

Large face mills should be mounted on a face-mill grinding attachment designed for the purpose. There are three operations required: The grinding of the face of the teeth, the periphery of the teeth, and the corners of the teeth. The operations are similar to those of sharpening a shell end-mill. The corners of the teeth should be rounded off by first grinding a 45-degree flat, and then angles of 22 1/2 degrees are ground on both sides, as shown in Fig. 9. The face edges should be 3/16 inch wide, and the remainder should be ground off at an angle of about 7 degrees toward the center of the cutter. If an accurate circle or arc is required, a radial grinding fixture should be used. Figs. 3, 4, and 5 show a typical set-up for grinding an 18-inch diameter face mill.

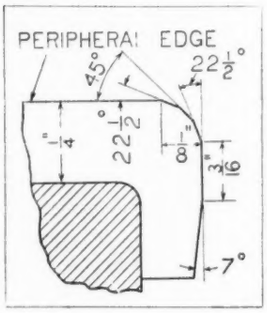


Fig. 9. Grinding the Corner of a Face-mill Tooth

In grinding a shank end-mill, the cutter-shank is held in the taper of the work-head spindle, to duplicate the working position of the cutter in the milling machine. End-mills with shanks should not be located on centers for sharpening, because of the chance that the mill may be sprung and so will be ground out of relation to the shank. The tooth-rest is fastened to the table, and the work-head is swiveled to give the required tooth clearance, as indicated in Fig. 7.

For grinding the corners of a shell end-mill, the mill is mounted on an arbor supported by the work-head, as indicated in Fig. 10. The head is swiveled to a 45-degree angle, and the wheel-head is raised or lowered to obtain the required clearance. The mounting of the tooth-rest on the work-head is to be preferred, since it allows the work-holder to be adjusted without disturbing the tooth-rest.

Helical milling cutters are mounted on an arbor between centers for grinding, as shown in Fig. 11. The tooth-rest should have a slight curvature or radius, and the cutting face of the wheel should be rounded to about 1/16 inch radius, tapering back to the full thickness of the wheel. The tooth-rest is set so that its center only will be in contact with the cutter at a point opposite the center of the wheel. Thus the cutter, wheel, and tooth-rest will be in contact at a common point, and the sharpening may proceed as with any milling cutter.

If the wheel face is left square, the wheel-head should be tilted slightly. Allowance must be made in the tooth-rest setting for the angle of helix, so that the resulting clearance angle will be correct.

Saws are usually ground with a 5-degree clear-

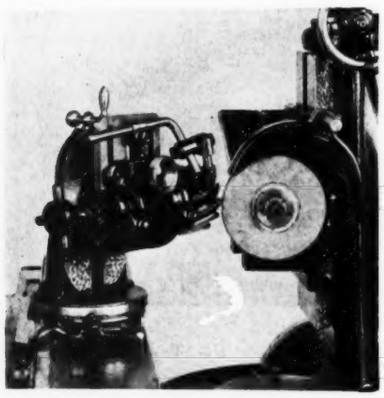
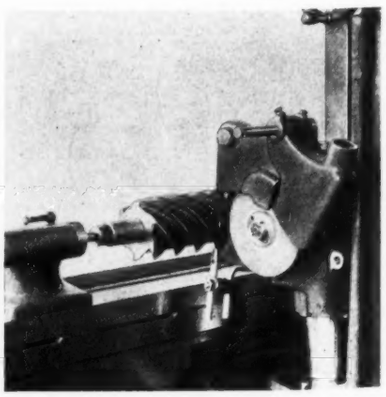


Fig. 10. (Left) Beveling the Corners of a Shell End-mill

Fig. 11. (Right) Grinding a Helical Milling Cutter with Steep Helix



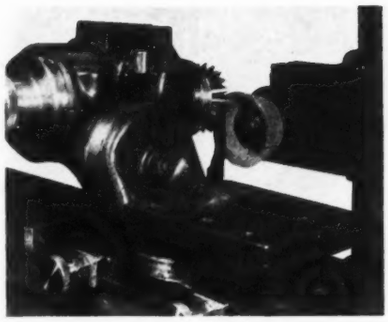
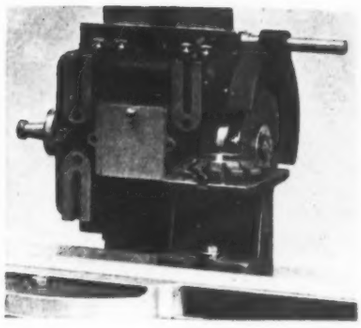


Fig. 12. (Left) Grinding the End Teeth of an Angular Milling Cutter

Fig. 13. (Right) A Method of Grinding a Narrow Formed Cutter



ance angle. To compensate for wheel wear, the saw should be divided into quarters, the grinding starting at a new quarter with each complete rotation of the saw. The saw may be mounted on a sliding shell on a cutter-arbor and move across the wheel face by sliding it along the arbor, or the table may be traversed. The dressing action of the small teeth on the grinding wheel is considerable, so that harder wheels than ordinarily employed should be used. Fig. 8 shows a typical set-up.

In grinding angular cutters, as shown in Fig. 6, the cutter is held on the end of the work-head spindle, which is swiveled to the angle of the cutter. The tooth-rest is fastened to the work-head and the table traversed across the wheel face.

The mounting of an angular cutter for grinding the end teeth is similar to the mounting for grinding the angular teeth. The teeth are ground slightly low at the center by swiveling the work-head from 1 to 2 degrees. The work is traversed across the wheel face and the tooth-rest is fastened to the table. The set-up is shown in Fig. 12.

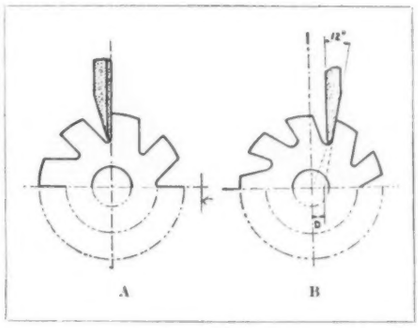


Fig. 14. Position of Wheel Face when Grinding Formed Cutters with Radial and Offset Teeth, Respectively

Formed cutters, such as gear-cutters, must be ground radially and equidistantly on a dish wheel. The face of the wheel must be on the radial center line of the cutter, as shown at *A* in Fig. 14. The position of the wheel face and cutter for the radial type cutter is shown at *A*, and for the offset cutter at *B*. Formed cutters may be ground on a cutter grinder or on a surface grinder having the required fixtures. The tooth-rest is on the back of the tooth being ground.

The following precautions should be observed: (1) The wheel face must be in line with the center of the cutter, except for offset cutters. (2) The wheel face must be trued carefully with the diamond held in a fixture. (3) The wheel must be located carefully relative to the work. Grinding is done on the side of the wheel, with a light feed.

Fig. 13 shows the grinding of a narrow formed cutter. The cutter is laid on the tool-rest, which is bolted to the table, and fed to the wheel by hand. Great care must be taken to grind the cutter radially and to keep the faces of the teeth at the same height. This method is rapid, but requires some skill. A gear-cutter grinding attachment will give more accurate results.

A wide formed cutter, as shown in Fig. 15, is mounted on a gang arbor and is passed across the wheel face by traversing the table. To insure correct spacing of teeth, the backs of the teeth on a new cutter should be ground before grinding the face. To adjust the work to the wheel while grinding, the cutter can be revolved toward the wheel a slight amount by tapping lightly against the tooth-rest holder. This rotates the cutter a very small amount and keeps the face radial. Obviously, a dish wheel is used.

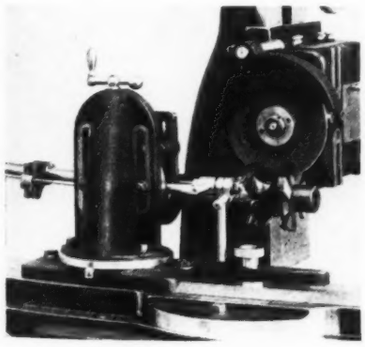
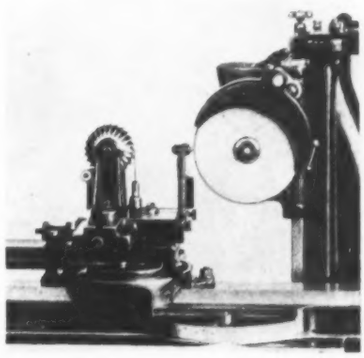


Fig. 15. (Left) Grinding a Wide-faced Formed Cutter

Fig. 16. (Right) Truing the Grinding Wheel for Radial Grinding



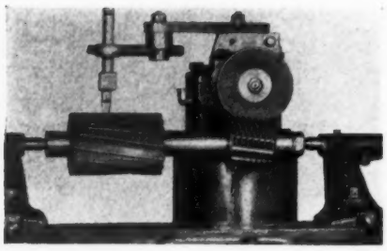
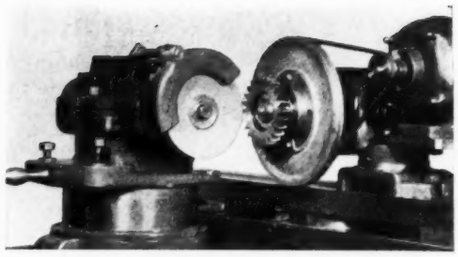


Fig. 17. (Left) Grinding a Hob with Spiral Flutes, Using a Master Form

Fig. 18. (Right) Grinding the Face of a Fellows Spur-gear Cutter



Hobs with straight teeth are ground radially on the faces of the teeth, in the same manner as formed cutters. For grinding hobs with spiral teeth, various methods are used. Several attachments are made by a number of machine tool builders for setting up hobs for grinding. The method shown in Fig. 17 involves the use of a master form as a guide for the tooth-rest. The master form is milled with the same spiral as the hob, and its accuracy determines the accuracy of the hob after grinding. The wheel should be trued to a sharp edge and to the same angle as the cutter that milled the hob.

The sharpening of Fellows spur-gear cutters, Fig. 18, is a plain grinding operation, performed with a cylindrical grinding attachment. The cutter is held on a stud mounted in the work-head, which is set to an angle of 5 degrees, representing the rake of the cutter.

Truing the Grinding Wheel for Radial Grinding

Before grinding a cutter with a radial grinding attachment, the wheel should be trued to the radius which is to be ground (Fig. 16). The diamond-holder is placed in position and the slide set for the required radius. There are two methods of doing this: (1) Lock the table longitudinally, the wheel running at right angles to it. Swivel the diamond and feed the wheel to it with the cross-feed on the table. (2) Set the wheel parallel to the table, bring the diamond into line with it, and feed forward with the longitudinal table feed while the diamond is swiveled. These instructions apply to the Brown & Sharpe cutter grinder. Other attachments do not require the truing of the grinding wheel, but merely rotate the work on a pivot central with the wheel face.

After the wheel is properly trued, the table should be locked, the attachment work-slide should be drawn back, and the diamond removed. The wheel should then be raised or lowered sufficiently to give the necessary clearance. The relation of the wheel to the attachment pivot should not be altered.

The Grinding of Convex and Concave Cutters

Convex and concave cutters are then set up for grinding as shown in Figs. 19 and 20. For the convex cutter, after the wheel has been trued to the correct radius, the tooth-rest is set in position at the same height as the center of the work-holder. The work is brought forward to the wheel by moving the attachment work-slide.

For concave cutters with fine teeth (Fig. 20) the wheel diameter should be small enough to clear the teeth on either side of the one being ground. The wheel is trued to the correct radius and the work adjusted as in setting up for grinding convex cutters. The small wheel, rotating at a relatively low peripheral speed, will wear quite rapidly, so that frequent truings will be necessary. Harder wheels than ordinarily used should be employed.

Credit should be given to the Brown & Sharpe Mfg. Co., the Cincinnati Milling Machine Co., the Landis Tool Co., and the R. K. LeBlond Machine Tool Co. for the use of illustrations contained in this article.

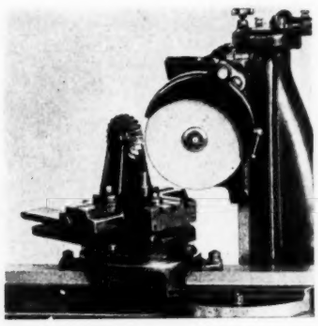


Fig. 19. Set-up for Grinding the Teeth of a Convex Cutter

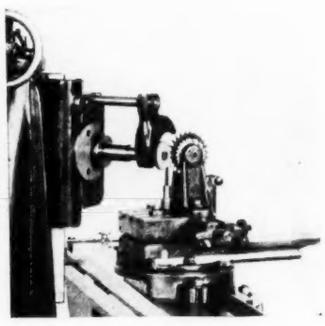


Fig. 20. Set-up for Grinding One-Half of a Concave Cutter

A Machine Tool Replacement Program that Pays Dividends

To Replace the Machine Tool Equipment Every Seven Years in a Plant Building Machine Shop Equipment May Seem Like an Extravagance. Here is a Plant that has Proved it to be Profitable

By H. GOLDBERG, Vice-President
R. G. Haskins Co., Chicago, Ill.

LARGE manufacturing companies usually have some policy of machine tool replacement. While each one has a different problem, the policy should be a definite one. Although there may be no set rule as to the time of replacement, method of procedure, or details of policy, almost all manufacturers agree that some definite plan should be established.

The small manufacturer, as a general rule, has no definite policy for replacement of machinery and other shop equipment; and when asked why no definite policy is in effect, he usually answers that he cannot afford to replace machine shop equipment as the larger manufacturer does. This is a very short-sighted policy. It is just as important for the small manufacturer to have some definite arrangement for replacement as it is for the large plant. There is no reason why the replacement of obsolete or worn-out equipment cannot be done in accordance with a predetermined plan to fit each manufacturer's requirements.

When a definite policy of capital expenditures has been established, it can be shown that it is clearly profitable to buy new machines to replace old ones. Machine tools, as a rule, are very inexpensive for the amount of work that they perform, and the cost of replacement is negligible, when the saving due to increased efficiency is taken into account. Then, when a definite replacement policy is established, there is the advantage of always having a modern shop. The company with which the writer is connected has adopted such a definite policy. It has been in effect for a sufficient length of time to prove its advantages in practice.

A Definite Average Age, Once Settled upon, Facilitates the Carrying out of the Program

About fourteen years ago we decided from our experience that the average length of time that we should keep a machine in our plant was seven years, and that each machine, after it reached this age, would automatically be replaced. A reserve was set up to take care of this, and in the last fourteen years we have replaced our entire factory equipment twice. Actually, during the first seven years all the machine tools in the shop were replaced. We are now at the end of the second seven-year period and there are only two machines left to be replaced this year.

This may sound like an expensive arrangement, but it has actually proved to be a very profitable one. The machines replaced were not old and were in good condition, so that they were disposed of at an attractive figure. In fact, the average for all the machines disposed of in the last fourteen years is 47 per cent of their initial cost. We believe that having the use of the machine tools for seven years and then selling them at almost half their initial cost makes our machine investment very low.

Not only has it proved a good investment from a dollars and cents standpoint, but it is a wonderful investment from a manufacturing standpoint, in that we have not had to worry about being put out of business because of our plant being obsolete. Furthermore, we have less supervision, inspection, and rejects, because our equipment is always up to date and no machines are worn out in the period that we use them.

The High Second-Hand Value of Frequently Replaced Machinery is an Important Factor

We believe that it is good policy to replace equipment before it is worn out and while it is still in good condition, because the replacement value is much greater. If we were to keep our equipment until it was badly worn, it would only have a junk value. We actually believe that we have made a handsome profit on the replacement of our equipment at the end of seven years. We do not trade in our equipment to the manufacturer who originally sold it to us, as we prefer to dispose of it in the most profitable manner.

It might also be mentioned that when we dispose of a machine tool that is seven years old, it is in almost as good condition as when it was purchased, because we have a definite maintenance policy. We do not neglect, or permit any of our employes to abuse, the equipment, and the machines are always maintained at the highest point of efficiency. In this way, we do not have any "down time" due to serious repairs, or broken tools due to abuse. The care given our machinery makes the maintenance cost less in the long run, and our employes appreciate machines that are in good condition. Unfortunately, many manufacturers do not reason along these lines, and are actually paying the price for new machines without having them. Ultimately, they have a profitless shop full of old machines.

Many manufacturers who have visited our plant have remarked that our factory looks as if it had all new machinery, and when we explain our replacement policy to them, they say that we must be either an immensely wealthy company or that we must be able to make excessive profits on our product. When they are shown that our line is a highly competitive one, they seem to think that we have some magic trick; it is hard to convince them that a definite policy of replacement is the cheapest from every angle of figuring.

It might be well to mention in conclusion that we also have a policy in regard to our relations with our employes that has proved highly satisfactory. It would be a short-sighted policy to establish a definite replacement plan for the machine tools and then neglect the employes who operate them. We believe that capable men like good machine tools, and that good machine tools are best operated by capable men.

Apprentice Training

An Urgent Job for American Industry

The Importance of Organized Training of Young Men for the Mechanical Industries was One of the Keynotes at the Recent Meeting of the Machine Tool Builders

At the fall meeting of the National Machine Tool Builders' Association, the Committee on Apprenticeship Training, of which Everard Stubbs, factory manager of the Fellows Gear Shaper Co., Springfield, Vt., is chairman, presented a report that emphasized the importance of systematic training of skilled men for the industries. The report called attention to the fact that there is already an acute shortage of skilled men in the mechanical industries. This is largely due to the five years of depression, during which few men have been trained, and partly to the increasing complication of manufacturing requirements, which calls for more highly skilled men in the machine-building branches of industry.

The problem that now faces the mechanical industries is to train men as rapidly as possible, men who will not only be more skilful than those of the past, but who will be more adaptable and quicker to understand new mechanisms. At first, this task seems extremely difficult; but those who are in close touch with the training of apprentices recognize that, whereas in earlier days but few boys were mechanically minded, today most boys are well versed in handling fairly complicated mechanisms, because of the common use of automobiles, radios, and mechanical devices in general. The tempo of modern life has fitted the boy of today for faster training than was the case a generation ago.

There are several well-known methods of training, each having distinct advantages, as follows:

1. *Apprentice Courses*—This is the earliest form of training. The advantages of the system are that apprentices are started at an early age and are trained over a relatively long period of time. The weakness in practice lies in the tendency to narrowness. Where there are specialized manufacturing conditions, the temptation is to train for one shop, and even for one specialty within that shop, and to neglect the apprentice's general education.

Many modern apprentice courses have overcome this difficulty. For those interested in studying modern apprentice systems, the committee listed the following sources of information: Brown & Sharpe Mfg. Co., Providence, R. I.; Cincinnati Milling Machine Co., Cincinnati, Ohio; General Electric Co., Schenectady, N. Y.; Ford Motor Co., Apprentice School, Dearborn, Mich.; National Metal Trades Association, Chicago, Ill.; and the International Correspondence Schools, Scranton, Pa.

2. *Trade Schools*—Through the trade school, the

regular school system attempts to meet the demand for a practical education. Though more fundamental and in certain respects broader, the trade school method cannot be as thorough in trade training as the apprentice system. Most serious of all, the trade school has difficulty in reproducing the air of reality, and particularly the pace of actual manufacturing conditions. Trade schools, however, should be encouraged, as they furnish one of the available training means for the industries.

3. *Mechanics' Arts Courses*—Many high schools now offer improved manual training courses. These courses have characteristics similar to those of the trade schools and are about on a par with them, except that the training often commences when the boys are younger.

4. *Cooperative Courses*—Having come to the conclusion that the product of the older apprentice systems was under-educated for life, and that the product of the regular engineering school was over-educated for industry, Dean Schneider, of the University of Cincinnati, combined the best points of both systems by instituting an ingenious cooperative engineering course at that university. Many high schools have adopted a similar plan; and when graduates from such high-school courses continue their training in cooperative college courses, they should be able to step into industry at once as valuable men who already know the manufacturing applications of their college training. This system has the advantage of starting the boy young, training him under production conditions, and coordinating theory and practice; it also places the classroom work in the school, which, in the case of smaller factories at least, is less expensive and more efficient.

5. *Short Courses*—Under the term "vestibule schools," brief training courses were popular during the war period, and many of these have been revived during the present emergency. The Norton Co., Worcester, Mass., has had experience with such courses. The advantage gained is that men without previous experience can be rapidly trained as useful specialists.

The committee making the report abstracted in the preceding paragraphs found that, out of the larger units in the machine tool industry, twenty-one are training apprentices. Thirty plants in all reported; these employ 15,500 men in total. In the twenty-one plants, 600 apprentices are being trained. This is about 3.8 per cent of the total number of men employed in these thirty plants.

The committee does not undertake to suggest a correct proportion of boys to train, but mentions that two machine tool builders with long experience find that approximatelv 4 per cent of the employes, over a long period of years, have been apprentices. On an average, 8 per cent of the men now employed are graduates of apprenticeship courses. In the case of one plant, the figure is as low as 2 per cent, while in another it is as high as 33 per cent. Several machine tool builders are employing as many as three of the different methods of training men outlined in the foregoing, and one company is using four of the plans suggested.

Marked Activity in the British Machine Tool Industry

According to reports submitted by Consul William W. Heard, Birmingham, England, to the Bureau of Foreign and Domestic Commerce, the British machine tool industry, especially in the Birmingham district, has been engaged to capacity for a number of months, following an all around improvement in the general engineering and machine building industries. Current demands for many classes of machine shop equipment are said to be greater than the capacity of the plants, and many machine tool shops are working over-time. Delivery dates on ordinary types of lathes are from four to five months ahead. There is a marked shortage of skilled labor, so much so that one firm has had to refuse a number of recent orders, which business has gone to the United States or to Germany.

Part of the activity is due to the intensive production of aircraft in connection with the air defense program of the British Government. Other national defense measures, as well, are stated to have greatly increased the activity in the machine tool building field. The automobile industry is also a prominent buyer of machine tools, there having been a considerable number of plant extensions. Orders for automotive machine shop equipment is likely to increase in volume after the 1936 cars get into full production during the next few months. The activity of the railroads and the electrical and radio industries are also contributing factors.

Most of the business is for the domestic field, the British machine tool exports having shown a steady decline since July. The value of the exports in that month were over $1,000,000. In August this figure was about $900,000, and in September $750,000. This decline is due partly to a decrease in exports to Russia, and partly to an increased home demand, which makes it impossible to make reasonably early deliveries abroad.

The machine tool imports into Great Britain during the past year have increased considerably, as compared with 1933 and 1934, although there was a decline during the month of September, compared with the previous month. This may have been only a temporary recession.

Engineering News Flashes

The World Over

"Gentle" Explosions in Coal Mines

Because large pieces of coal are more valuable than small ones, and because of the fumes that hamper work and sometimes endanger life during blasting, some coal-mining areas in Illinois and Indiana have discarded dynamite blasting in favor of compressed air blasting. Specially designed compressor drives, motors, and control devices have been developed by the General Electric Co. for a new type of equipment built and introduced into the mining districts by the Sullivan Machinery Co.

With the new equipment, the coal is gently pushed out of place by air pressure instead of being violently dislodged by dynamite explosions. The new method includes a portable compressor which stores up air at pressures up to 15,000 pounds per square inch in long metal cartridges. A cartridge is inserted in a hole drilled in the face of the coal, and a valve suddenly releases the air, which, in expanding, pushes out the coal in big chunks. The steel cartridges can be used over and over again and can be filled in ninety seconds. The miners with their equipment retreat to a distance of 100 or 150 feet during the "explosion."

Paper Records for Phonographs

A new method of sound recording which, it is claimed, will make it possible to sell a 12-inch phonograph record for 5 cents was recently demonstrated in London. Developed by an Argentine engineer, the system, known as the "Fotoliptofono," is similar in principle to the "sound-on-film" recording. The sound is first recorded on a celluloid negative, from which a reproduction on paper is made which is placed on a rotating cylinder and through which sound reproduction is effected by means of a photo-electric cell. Negotiations for the commercial development of the invention are said to be in progress with British phonograph companies.

New Low-Cost Rustproofing Process

Excellent rustproofing at low cost is claimed for cromodizing, a new process developed by the American Chemical Paint Co., Ambler, Pa. The new process prevents rust from forming beneath paint films. It is adapted for protecting any type of steel surfaces, irrespective of size, shape, or previous processing. The cost of the process is low, and it is therefore available in a very wide field of steel products. It is said that prominent automobile manufacturers now using this treatment have found that it will triple the life of the finish on steel parts. The process consists of dipping steel products in a bath of a chemical known as "Cromodine." The surface can also be sprayed with this solution.

Light British Airplanes in Production

Light airplanes sold at an unusually low price are now being made by F. Hills & Sons, Ltd., Trafford Park, Manchester, England, according to an item in *Industrial Britain*. The cost of a single-seater plane, including the engine, is only $850. This plane has a wing span of 19 feet and a length of 13 feet. The width can be reduced to between 4 and 5 feet when the main wing is brought around in line with the body. The plane can be housed in a garage and is light enough for one person to wheel about. A two-seater is also being built which sells for about $1900. This is built under a license from Czechoslovakian patentees, and is known on the Continent as the Praga 114. In recent races, ten of these planes were entered. One of them attained a maximum speed of 93 miles an hour, an average speed of 77 miles an hour, and made approximately 43 miles per gallon of gasoline.

Saving 80 Per Cent on Welded Repairs

An interesting example of savings through the use of arc welding in repair work is furnished by the General Electric Co. A forging machine head developed a fracture. The cost of a new casting would have been $1000. A satisfactory welding repair job was done for $200, a saving of 80 per cent of the cost of a new casting.

The three-ton head of the forging machine had broken in three pieces. In making the repairs, the Menna Welding Co. of Toledo, Ohio, prepared the fracture for welding by cutting away a small amount of metal and inserting a number of steel studs in the surfaces to be united. The use of such

studs is common practice in the welding of cast iron. They add the mechanical strength to the joint that cannot be obtained by depositing weld metal alone on cast iron.

British High-Speed Train Service

The London & North-Eastern Railway has placed in operation between Newcastle and London a high-speed train with the cars built on the articulated principle; the entire train, including the locomotive, is of streamline design. The train makes the run from London to Newcastle, 268 miles, in four hours exactly, with one stop in each direction—an average speed of sixty-seven miles an hour.

Training Course at British Automobile Plant

A very complete apprentice system is being conducted by the Austin Motor Co., Ltd., at Birmingham, England. The apprenticeship course covers four years of instruction, the minimum age for entering being seventeen. In addition to the training at the shops of the Austin Motor Co., instruction is provided by the Birmingham Central Technical College. Besides apprentices from Great Britain, there are young men in the group from South Africa, China, New Zealand, Spain, Germany, Argentina and Portugal, who have come to England for a course in automobile construction.

Tiering Machine of Huge Proportions

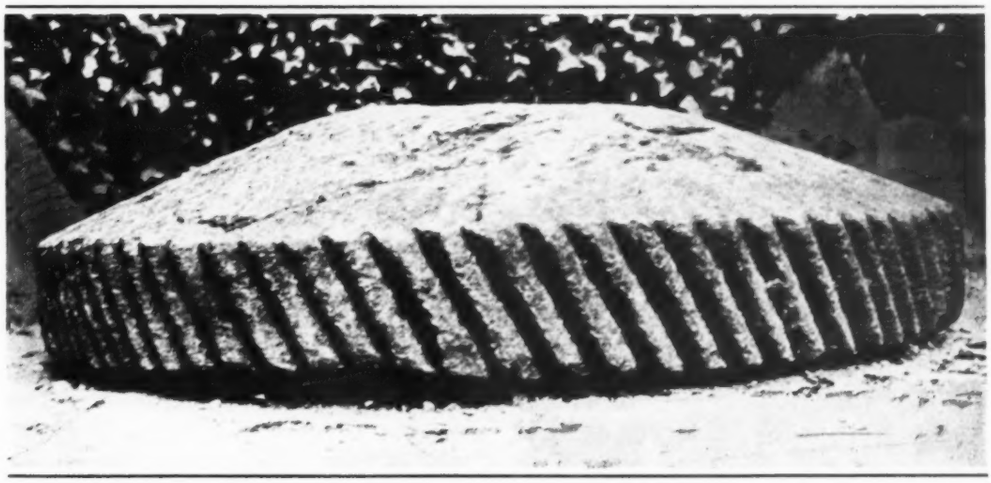
In the new sheet plant of the Youngstown Sheet & Tube Co., Youngstown, Ohio, a gas-electric tiering machine that is the largest of its kind has been installed. It is used for handling sheets to and from the shears, rolls, scales, warehouses, etc. The new tiering machine is capable of handling sheets of any width from 1 to 6 feet and of any desired commercial length. It is built by the Ross Carrier Co., Benton Harbor, Mich., and is provided with General Electric motors and control.

The tiering machine carries its own gas-electric power plant. In operation, it runs over or straddles the load, and the operator then applies power to a mechanism that engages the load and lifts it, after which it can be transported to any point in the plant. Material can be hoisted to a height of 6 feet. Loads up to 15 tons can be handled at a hoisting speed of 6 feet per minute. All operations are controlled from the driver's seat.

A New De-Tinning Process

A new process has been developed in Great Britain in which acetic acid is used instead of chloride for de-tinning. The process is claimed to be safer and simpler than former methods. The treatment is carried out in a chamber containing acetic acid vapor. Water-soluble crystals are formed on the tin, but the iron is not attacked. The reaction will take place at ordinary temperatures, but is expedited by heating.

A helical gear cut from solid stone some eight or nine centuries ago was discovered in the ruins of an old castle in Sweden by Otto Lundell, president of the Michigan Tool Co., Detroit, on a recent visit to that country. The gear was probably one of a train used to drive a grain crusher or flour mill. Although the gear has outlived any definite records of the use to which it was put, it shows an unusual conception of machine design requirements. The gear, for instance, is made thicker at the hub than at the teeth, to provide an adequate bearing area.



EDITORIAL COMMENT

One of the large automobile manufacturers, through an elaborate questionnaire, of which tens of thousands of copies were distributed, arrived at an unusually comprehensive idea of what the automobile user wants in a motor car. Similar methods, even if not on so elaborate a scale, could advantageously be applied to the design and manufacture of manufacturing equipment of all kinds.

There are some instances where the manufacturer feels that he is capable of deciding for himself what kind of machine will best serve his customer. On the other hand, we have manufacturers who will build practically anything that the customer wants, incorporating all of the latter's pet ideas. But most designing of manufacturing equipment lies between these two extremes—the manufacturer's experience being incorporated in designs that also express the customer's ideas.

It Pays to Make a Thorough Study of Customer's Needs

It remains a fact, however, that the customer's needs could be more thoroughly studied. It would doubtless be profitable for machine tool designers, for example, to spend considerable time in the type of plants for which the machines are mainly intended. If production machines are the chief product, a thorough knowledge of the conditions in an automobile plant would be useful. Just to pass through the plant and observe the general conditions under which work is performed is hardly enough. A more thorough study is required, which can be made only by taking sufficient time. It would be time well spent, because frequently very costly mistakes would be avoided. The needs of the user and the conditions in his plant cannot be too thoroughly understood by the equipment designer.

Frequently fault is found with the engineering colleges because their graduates have little or no knowledge of the requirements in design peculiar to a specific branch of industry. It is said that the colleges do not provide sufficient practical training in machine design. Such statements are due to a lack of imagination on the part of the critic himself. It is evident that all that enters into design problems in the hundred and one different branches of industry could hardly be taught satisfactorily in a college course. Even as it is, many college courses tend toward too great specialization. The best engineering training that a college can provide is a broad education in fundamentals.

Engineering Schools Should Not Educate Specialists

Every branch of industry has a great number of problems of its own. The only thing that the college should be expected to do is to point out the existence of these innumerable problems with which the designing engineer must deal, giving the student an "airplane view," as it were, of the tremendous ramifications of industry and engineering. If the college has given him a background that will enable him to comprehend an engineering problem quickly, and to find a solution systematically and logically, it has done its job well.

In many plants well equipped for performing the machining and assembly operations required in the manufacture of their product, the question of shop transportation is not given the same careful attention as the manufacturing operations. Materials and partly finished parts are moved about the plant without a careful scrutiny of efficiency and cost.

Materials-Handling Equipment as a Means of Reducing Costs

With the modern means available for moving of materials and parts about the plant, it is possible to greatly reduce costs in the handling of a product. The lay-out of the plant has a highly important bearing on this point. Some time ago one plant that was laid out entirely on the departmental principle, performing only operations requiring the same type of machines in each department, had to truck parts back and forth to an extent that was wholly unnecessary and extremely costly. By rearranging the machining equipment so that, where possible, consecutive operations were performed in the same department, even though handled on machines of different type, a great deal of trucking was eliminated.

Several of the firms who are making materials-handling equipment have studied the conditions relating to materials-handling in many different plants and are in a position to give advice to manufacturers that will help to solve their problems.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers
as Typical Examples Applicable in the Construction of
Automatic Machines and Other Devices

Pneumatic Overload Relief Mechanism for Disengaging Clutch at Remote Point

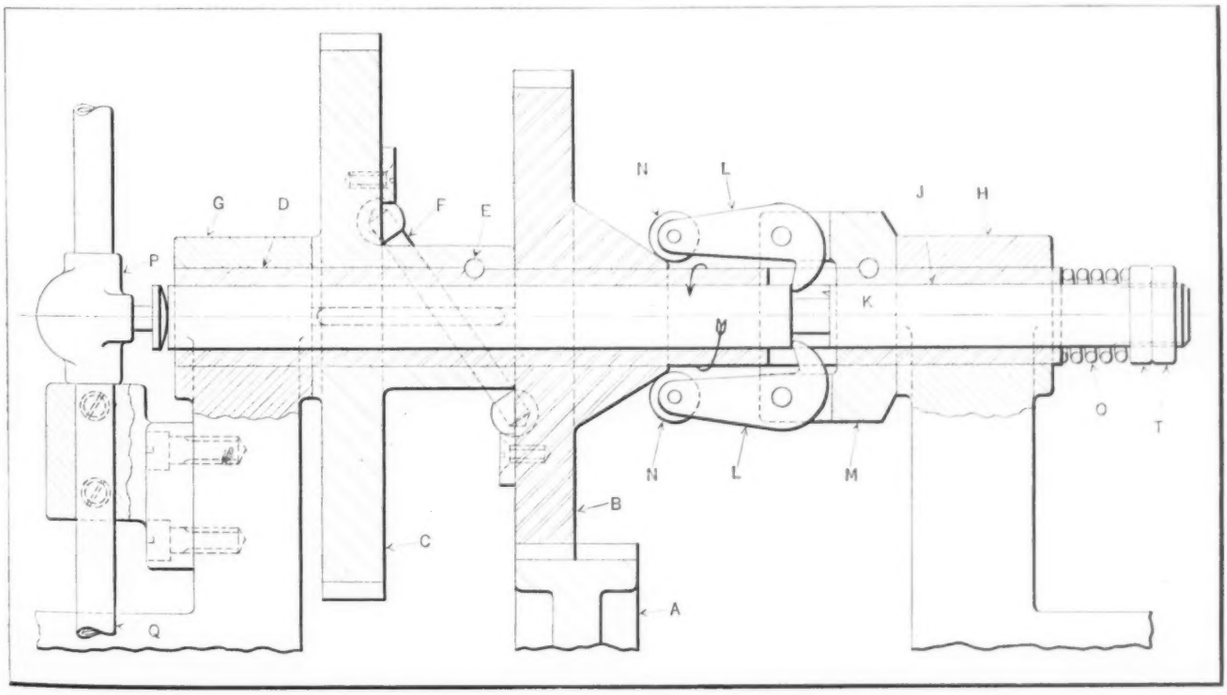
By J. E. FENNO

A conveyor system is employed in a certain plant for delivering gravel over a relatively long distance to a washing and screening machine. Too large a quantity of material fed into the machine is likely to cause damage; to prevent this, an overload relief mechanism is provided on the machine for stopping the conveyor, the power for which is applied at some distance from the point of delivery of the gravel. With this arrangement, the relief mechanism opens a valve in a compressed air line when the machine is overloaded and delivers air to a cylinder, the piston of which disengages the conveyor clutch.

This mechanism is shown in the illustration, although the air cylinder and conveyor clutch are omitted, as their design is generally known. The driving gear *A*, which rotates at a constant speed, transmits the required rotary movement to the machine through gears *B* and *C* and another gear (not shown). Gear *C* is secured by pin *E* to the hollow shaft *D*, supported in the stationary bearings *G* and *H*. Gear *B* is a running and sliding fit on this shaft, but when the machine is not overloaded, is caused to rotate with gear *C* by the bar *F*. Balls secured to the ends of this bar engage corresponding ball sockets in gears *B* and *C*.

Plunger *J* which operates the valve *P* in the compressed air line *Q* when the machine is overloaded is a sliding fit inside of the hollow shaft. Plunger *J* contains a groove *K* which is engaged by the two fingers *L*. These fingers are pivoted in the collar *M*, which is pinned to the hollow shaft. At the left-hand ends of fingers *L* are rollers *N*, which rest on the tapered hub of gear *B*. The fingers *L*, gear *B*, and plunger *J* are held normally in the position shown by the coil spring *O*. The collar-nuts *T* provide the necessary adjustment for setting the tension of spring *O* to hold gear *B* in the position indicated when the machine is not overloaded.

In operation, gear *A* rotates shaft *D* in the direction indicated by the arrow. When the machine is



Mechanism for Pneumatically Disengaging Clutch at Remote Point when Machine is Overloaded

running under a normal load, gear *B* maintains the axial position shown. However, if the load becomes excessive, the pressure against the ball ends of bar *F* will increase so that the bar will push gear *B* toward the right. As this movement occurs, the tapered hub of gear *B* opens fingers *L*, which causes plunger *J* to be forced toward the left and the button in valve *P* to be depressed.

In this way, air is admitted to the line *Q* leading to the clutch-operating cylinder, which causes the piston to disengage the clutch and stop the conveyor. When the excessive load on the machine is relieved, gear *B* once more returns to the normal position shown, causing plunger *J* to move toward the right and close the air valve. Springs provided on the air cylinder then return the piston and thus re-engage the conveyor clutch.

It should be mentioned that a small hole is drilled in the air cylinder head at the pressure end to permit the air to escape when the piston is actuated by the springs. This allows the air to leak out of the cylinder fast enough to permit the springs to return the piston when the air valve *P* is closed, but not so fast that full line-pressure will not operate the piston. This leak hole has another important advantage in that it prevents the operation of the clutch cylinder through leakage which might occur in the valve *P*.

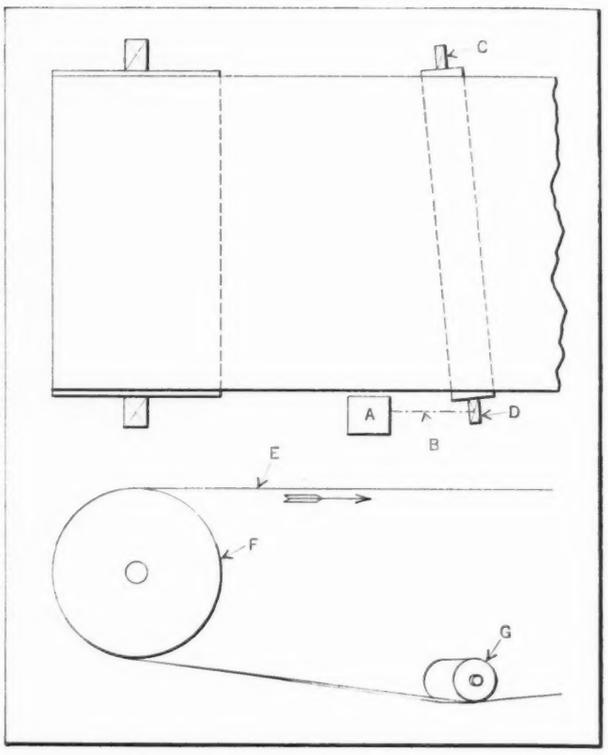


Fig. 1. Diagram Showing how Swinging Idler Roll is Actuated by Mechanism Shown in Fig. 2

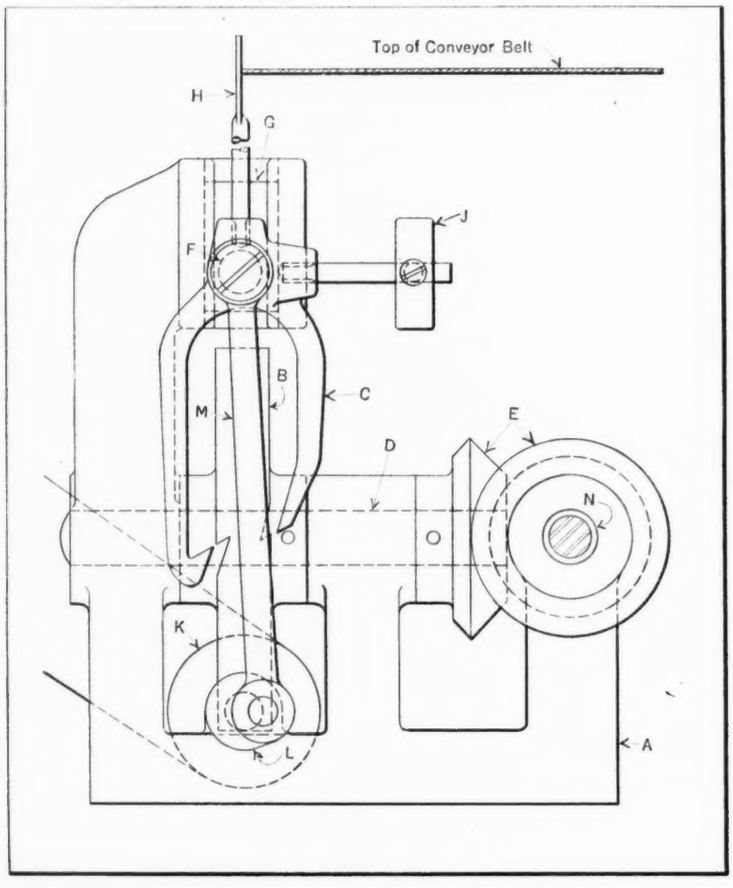


Fig. 2. Ratchet Mechanism for Automatically Swinging the Idler Roll into Position to Prevent Creep in a Wire-mesh Conveyor Belt

Mechanism for Preventing Creep of Wire-Mesh Conveyor Belt

By F. E. JUDSON

Wire-mesh belts are used in a certain plant for feeding lacquered parts through drying ovens. Because of unequal stretching of the wire, however, the belt had a tendency to creep to one end of the driving roll and against the machine frame. This often resulted in damage to the belt. To overcome this difficulty, an idler roll was incorporated, as indicated at *G* in the diagram Fig. 1.

This roll is pivoted at *C*. End *D* is automatically swung either to the right or left, according to the direction of belt creep. For example, if the belt *E* creeps toward the rear of the driving roll *F*, idler *G* immediately swings toward the right, causing the belt to return to its normal path. If, on the other hand, the belt creeps toward the front, the idler will swing toward the left and return the belt as before to its normal path.

The automatic movement of this idler is produced by means of the ratchet mechanism shown in Fig. 2. This mechanism is indicated at *A* in Fig. 1, and operates a screw represented by the dot-and-dash line *B*. This screw engages a

nut on the swinging bearing *D*. Base *A*, Fig. 2, is stationary, and on it is mounted ratchet wheel *B* and the double pawl *C*. The ratchet wheel is pinned to shaft *D* and has closely spaced teeth cut on each side which are engaged by the pawl. Pawl *C* is pivoted on stud *F* in the vertical slide *G* and has an extension paddle *H* which is kept in contact with the edge of the belt by the counterweight *J*.

Slide *G* and pawl *C* are given a continuous vertical reciprocating movement by means of the pulley *K* through the crank *L* and the connecting-rod *M* which is pivoted at its upper end to the stud *F*. Pulley *K* receives its motion from another member of the conveyor (not shown). The screw engaging the nut on the swinging roll bearing is shown at *N* and is rotated by the ratchet wheel through the miter gears *E*.

With the pawl in the position shown, the belt is running in its central position on the driving roll; hence neither end of the pawl engages the ratchet wheel. However, if the belt were to creep, say, toward the left, the edge of the belt would force paddle *H* also toward the left, causing the pawl to swing on stud *F*. As a result, the hooked end of the pawl would engage the teeth in the ratchet wheel, rotating the ratchet wheel, miter gears, and screw *N*. As the screw rotates in the nut on the bearing roll, the roll is swung in the correct direction to guide the belt, through the angular position of the idler roll, back to the center of the driving roll.

If the belt should creep toward the right, the movement of the paddle would cause the straight end of the pawl to engage the right-hand side of the ratchet wheel. As the teeth on this side of the wheel are cut opposite to those on the other side, the screw would rotate in the opposite direction and cause the idler roll, in turn, to swing in the opposite direction.

Nine-Speed Gear-Box with Single-Lever Control

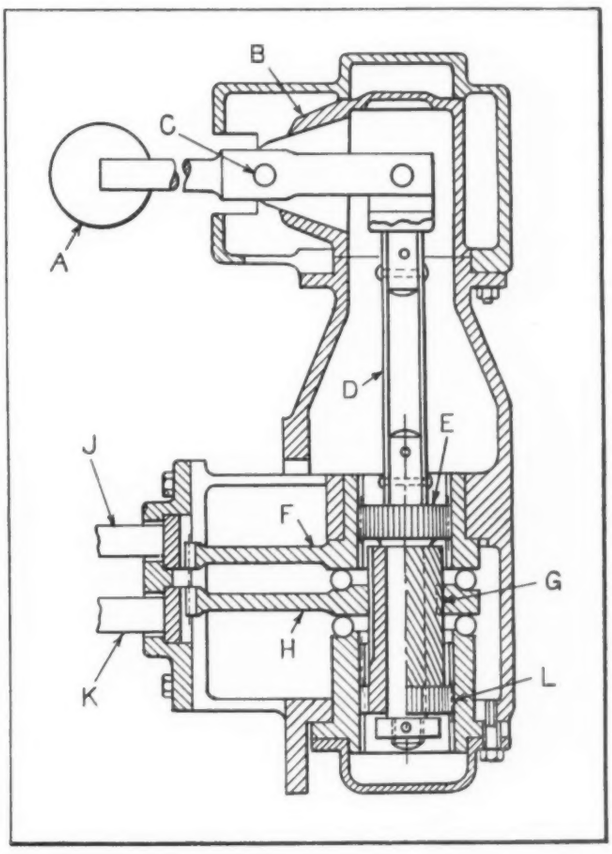
By PAUL GRODZINSKI

The single-lever control mechanism shown in the accompanying illustration permits the operator to obtain instantly any one of nine different speeds available in gear-boxes manufactured by Friedrich Steinruck, Berlin, S. W., Germany. For instance, with a driving motor running at 960 revolutions per minute, the gear-box gives nine speeds ranging from 10 to 50 revolutions per minute. These speeds are obtainable, in the usual manner, with three pairs of sliding gears on two parallel shafts, by sliding each group of three gears. The gears and the gear-box of conventional design are not shown, but the yokes that control the sliding gears are indicated at *J* and *K*.

The interesting feature of this drive is the arrangement for obtaining the nine changes of speed by means of the single lever *A*. A horizontal movement of lever *A* serves to rotate the segment gear *F*, which is in mesh with the rack teeth on the gear-shifting slide *J*, causing the slide to move endwise. A vertical or up and down movement of lever *A* imparts a similar sliding movement to the gear-shifting slide *K*, which has rack teeth meshing with the segment gear *H*. The range of movements imparted to the slides *J* and *K* by the horizontal and vertical movements of lever *A* permits any one of nine speeds to be selected.

When the handle *A* is moved horizontally, the housing *B*, in which the lever is pivoted at *C*, turns with the lever and the rod *D*. The teeth on gear *E*, secured to rod *D*, are a sliding fit in internal teeth in the hub of the segment gear *F*. Thus a horizontal movement of lever *A* transmits a sliding movement to slide *J* through the rod *D*, gear *E*, and segment *F*.

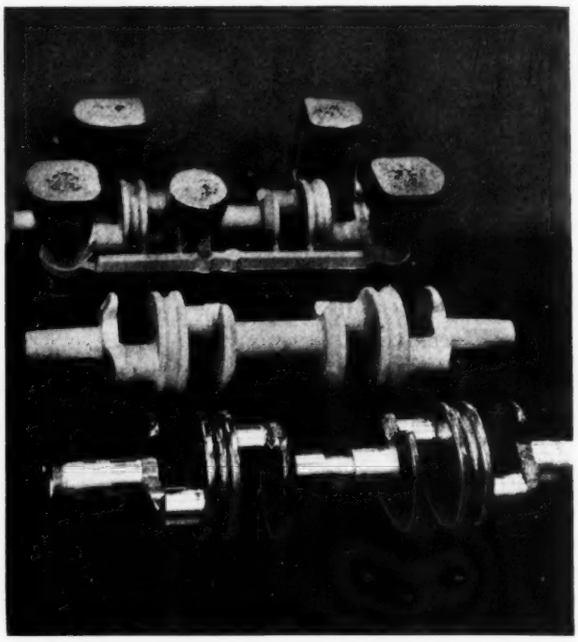
A vertical movement of lever *A* causes it to pivot on stud *C*, resulting in transmitting a vertical movement to rod *D*. The downward projecting end of gear *E* is a turning fit in the helical gear *G*; gear *G* has straight spur gear teeth at *L* meshing with teeth in the housing that prevent rotation of the helical gear. The vertical movement of lever *A* causes gear *G* to move vertically and impart a rotating motion to the segment *H*, which has internal helical teeth that are a sliding fit over the helical teeth on gear *G*.



Mechanism in which a Single Lever A Actuates Two Slides J and K that Control a Nine-speed Gear-box

New Applications of Nickel Steels and Alloys

A Review of Recent Progress in the Uses of Nickel Steels and Alloys in the Mechanical Industries



Nickel-molybdenum Cast-iron Crankshafts for Starting Engines of "Caterpillar" Diesels. At the Rear is a Casting as it Comes from the Mold; at the Center, a Casting with Risers and Shrink Heads Removed; in Front, a Pair of Finished Crankshafts Ready for Installation

IN a brief article on page 134 of October MACHINERY, the ever increasing extent to which alloy steels are being used was emphasized. According to the International Nickel Co., in 1934, when American steel production was only 11 per cent more than in the preceding year, the consumption of alloy steels increased 23 per cent. The use of alloy steels and irons in the automobile industry especially was referred to. The most remarkable application is, perhaps, the use of cast crankshafts, which are now regularly used in some automobiles, of which the Ford and the Lincoln cars are outstanding examples. The present article will deal with additional applications of alloy steels and irons in the automotive industry, and will review their uses in many other industrial fields.

Alloy Iron for Cylinder Liners

Truck and bus cylinder liners hardened to from 450 to 500 Brinell, previously considered impracticable because of machining difficulties, are now in regular production. Trucks so equipped have run 200,000 miles before reconditioning, as against 75,000 miles for the old type 250 Brinell unalloyed iron cylinder. The nickel cylinder irons commonly containing from 2 to 3 per cent of nickel, with additions of chromium or molybdenum, are pointing the way toward greater endurance in passenger car engines. The trend is toward similar improvements in piston-rings, exhaust manifolds, brake-drums, etc.

In addition to these applications to parts actually used on automotive vehicles, it is logical to consider at this point the metal-forming dies used in the fabrication of car bodies, fenders, and similar parts of automobiles. Nickel cast iron is almost universally used by the car and body builder for this purpose because of its wear resistance and the possibility of casting the dies very closely to the finished size, thereby reducing machining and tooling costs, compared with the use of dies hogged out of tool steel.

Aside from the use of alloy cast-iron crankshafts in tractors, and other well-known applications of nickel steels in these machines, much other agricultural equipment makes greater and greater use of alloy steels and iron. For example, a new mowing machine has its large driving gears cast in high-strength nickel iron, which is reported to give excellent results.

Alloy Steels for Railroad Equipment—A Recent Important Application

The growing demand for lighter weight construction in all kinds of movable equipment has been responsible for the progress during the past year in the development and exploitation of higher strength structural steel. The thinner sections made possible through increased strength necessitate improved corrosion resistance, if the life of the structure is not to be shortened by the rusting away of the material. Of course, nearly perfect resistance to corrosion, together with adequate strength, can be obtained by using the stainless steels, but they are too expensive to be substituted in everyday railroad use for the moderately alloyed steels.

Several nickel-alloy steels designed for corrosion resistance have been placed on the market under brand names and have achieved deserved recognition. The development of this class of steels, however, is still in its infancy, and there will undoubtedly be others appearing as experiment and field tests demonstrate their value.

It is obvious that these alloy steels should be suitable in the railroad field, where the need for a decrease in dead weight is especially great. We are all familiar with the Zephyr type of passenger trains, but for freight hopper cars, the use of high chromium-nickel stainless steel is as yet hardly practicable from an economic point of view. The intermediate alloy steels meet the present requirements.

The use of nickel-steel castings in the wheel trucks of railroad cars has proved highly successful in a number of installations. These castings have proved their superior toughness and shock resisting capacity. Coupler knuckles are another part in which failures have been appreciably reduced by the substitution of cast nickel steel for the carbon steels commonly employed.

The Application of Nickel Steel and Alloys in Marine Equipment

The use of copper-nickel condenser tubes and Monel metal shafting is steadily increasing, and nickel-steel welded hull plates are being tried out for large liners abroad. An interesting recent application was the nickel-steel mast used on the racing yacht *Yankee*, through which the weight was decreased 500 pounds, as compared with the wooden mast formerly used, while the wind resistance was cut quite appreciably.

Nickel Steels and Irons for Tools and Dies

Nickel is continually playing a more important part in auxiliary tooling equipment, especially in conjunction with chromium and other alloying elements. Arbors, chisels, blanking dies, gages, punches, and similar tools are made from nickel-alloy steels with excellent results. For drop-hammer die blocks, a nickel-chromium-molybdenum steel is probably the most widely used material, due to its depth-hardening properties, its low distortion factor, and its toughness and resistance to heat checking.

Hand tools, such as wrenches and screwdrivers, are now being regularly made of nickel-alloy steel, and definite improvements are recorded over the materials heretofore most commonly used for this service.

The nickel and other alloy steels are more than holding their own in machine tool construction, due to the increasingly severe burdens which the use of modern cemented-carbide cutting tools place upon the gears, racks, spindles, shafting, worms, lock-pins, dogs, and other parts of machine tools. The machining of heat-treated steel bar stock also places a greater strain on the equipment.

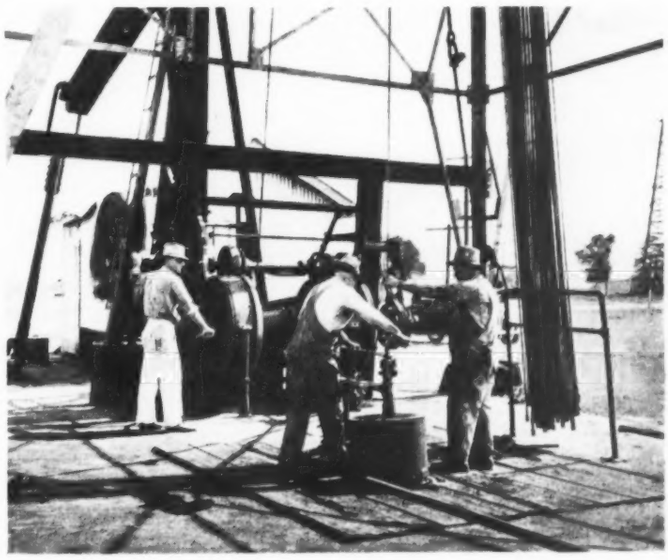
The trend to hydraulically controlled mechanisms demands castings that are dense and sound, even in heavy sections, in order to prevent oil leaks. Nickel cast irons meet this requirement and have been adopted for hydraulic cylinders. High steel mixture nickel cast irons are used for machine ways and slides, as they present good wearing surfaces combined with excellent machineability, and do not require the use of chills in casting. The use of this type of alloy iron has extended also to the beds, saddles, tables, turrets, and columns in order to obtain greater stiffness, strength, and toughness.

Nickel Alloys at Low Temperatures

During the past year, the question of the stability of steel for applications at temperatures below zero has been seriously discussed. Research has demonstrated that the most important effect of low temperatures on steel is a marked tendency to induce brittleness. Alloying with nickel has been found to be of value in lessening brittleness at these temperatures.

Various Other Uses of Nickel-Alloy Steels

In the oil-drilling industry, much attention has recently been given to the question of improved sucker-rod materials, especially since the opening up of new fields where sulphide corrosion is encountered. The principal requirement for this service is a high degree of resistance to corrosion. Extensive field tests have conclusively demonstrated the superiority of nickel-alloy steels, nickel



An Oil Well in Operation. The Batch of Sucker Rods Shown to the Right Ready for Use are Made from Nickel Wrought Iron by the S. M. Jones Co., Toledo, Ohio

wrought iron, and nickel alloyed ingot iron for this application.

Substitution of nickel-chromium steel dredge-pump liners at three times the cost of the previously used unalloyed steel has increased the life of the pumps six times. The greater economy of the higher cost material is obvious, even if the labor and material cost of replacing worn pumps, and the loss of effective working time of the dredge during repairs, is not considered.

Stainless Steel is a Nickel-Chromium Alloy

Much of the interest in nickel alloys centers, of course, in the stainless group. The 18 per cent chromium, 8 per cent nickel alloy, which continues to be the most popular composition of stainless steel, has been further improved during the past year to reduce intergranular corrosion after welding, and with the advent of the continuous, high-speed, localized heavy-current spot-welding process, this steel has received wider acceptance in the aircraft, railroad, and other fields where corrosion resistance, strength, and lightness of weight are essential. The most spectacular developments along this line are the high-speed streamline trains made possible through the perfection of the Budd "Shot-Weld" system.

Increasing Applications of Nickel Cast Iron

Alloy cast iron developments during the past year have been fully as interesting as those of the alloy steels. Evidence of a more widespread engineering acceptance of the value of alloy cast iron is found in the increasing use of this material in all types of machinery to obtain increased strength and lighter weight. The textile, shoe machinery, refrigeration, printing, glass-working, canning, and packaging equipment industries have become important consumers of large quantities of this metal.

There has developed a more widespread understanding of the ability of properly alloyed irons to resist wear, whether resulting from abrasion or erosion. Coke crushers handling from 200,000 to 400,000 tons, as against 50,000 tons when made of plain iron, constitute a typical example. On cement mill rolls the normal life of chilled white iron is about 700 hours. The use of "Ni-Hard," a white nickel-chromium iron, has increased this life to as much as 1200 hours.

The more highly alloyed irons of the "Ni-Resist" type, possessing a substantial resistance to corrosion, have become firmly established in many fields, including the oil, slate, glass, automotive, marine, coke, and gas industries.

The Non-Ferrous Nickel Alloys and Their Application

The uses of nickel bronzes are also steadily increasing. The huge bronze propellers for the Cunard liner *Queen Mary*, now under construction in Scotland, are an example. Plain bearings for automotive and similar uses are being made with small nickel additions—from 1/2 to 1 per cent—because nickel, even in small quantities, refines the grain size, making the metal more uniform throughout. The shock-resisting qualities are also improved.

Another recent development of importance is "K-Monel," a new alloy having up to 3 1/2 per cent of aluminum introduced in the regular Monel metal. K-Monel has all the corrosion-resisting properties of regular Monel metal, but in addition, by heat-treatment, its strength can be tremendously increased, while its hardness may be raised to over 325 Brinell. It is obvious that this metal is suitable for many important applications.

Another Monel alloy, "S-Monel," made with a high silicon content, is especially useful for its non-galling characteristics, and is, therefore, widely used for such parts as pump castings.

The alloy "Inconel" is an excellent material for springs subjected to high temperatures. It has remarkable resistance to corrosion and especially to oxidation at high temperature ranges. Following the success of nickel-clad steel, Inconel-clad steel has been developed during the past year. It has been found especially applicable to heavy plate equipment in which the desirable characteristics of the Inconel alloy are required.

* * *

Motion Picture of Stainless Steel

The first sound picture showing the manufacture, fabrication, and application of stainless steel has recently been completed by the Republic Steel Corporation, Youngstown, Ohio. The picture is considered one of the best examples of industrial motion picture photography. It makes use of off-screen narration to describe, in non-technical language, the scenes. Beginning with the mining of its principal component parts, such as chromium in Rhodesia and nickel in Canada, the film traces the various steps in the manufacture of stainless steel, and then shows important phases of fabrication, such as welding, soldering, spinning, drawing, and stamping. Following this are a large number of flashes of applications—from the Empire State and Chrysler buildings to dainty wrist watches and jewel mountings.

* * *

Leipzig Engineering Fair to be Held Early in March

The Engineering Exposition held in connection with the annual Leipzig Fair will be staged at Leipzig, Germany, from March 1 to 9, inclusive. Present indications are that the coming fair will be larger than those held for several years. Further information can be obtained from the Leipzig Trade Fair, Inc., 10 E. 40th St., New York City.

Precision Turning and Boring of Air-Brake Valves

An Expensive Grinding-In Operation is Eliminated by Turning and Boring Tapered Valve Parts on Precision Boring Machines

By C. A. BIRKEBAK, Engineer
The Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich.

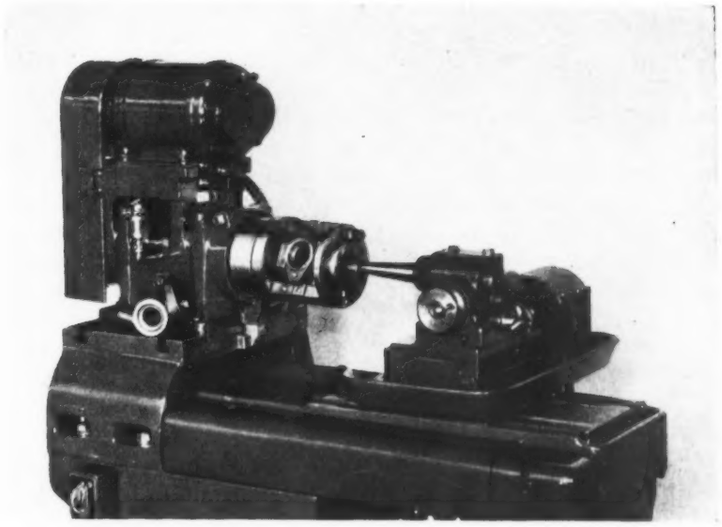
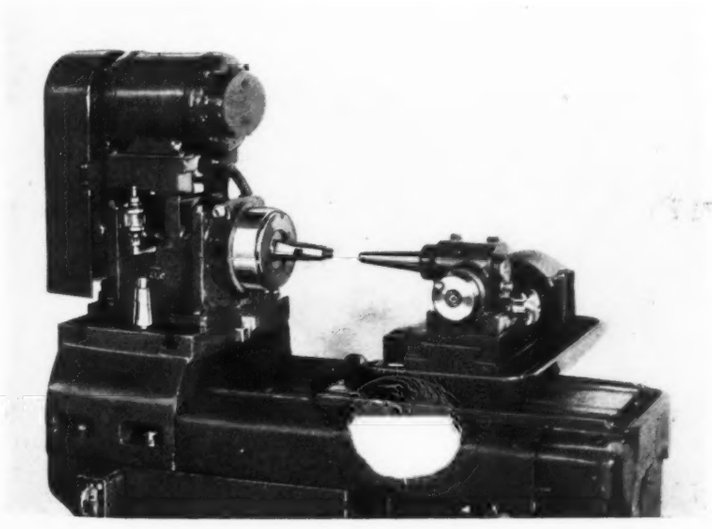


Fig. 1. Boring the Tapered Seat of Air-brake Valves to a High Degree of Smoothness by the Use of a Diamond Tool

AIR-BRAKE valves of a type used extensively in the railway field are made with a tapered plug or key that must seat accurately in a bore of corresponding taper in the valve body. The fit between the plug and its seat must be so precise that it will prevent any leakage of high-pressure air when the valve is closed.

With the methods used in the past for turning the tapered plug and for boring the tapered seat of these valves, it has been the practice, after these operations, to grind-in the two parts with emery dust in order to obtain the required fit. This grinding-in operation has been eliminated in several railway shops by turning and boring the tapered valve parts on boring machines of the precision type. The illustrations show two machines that have been built by the Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., for this class of work.

Fig. 2. Taper-turning Keys for the Air-brake Valves to Such a Degree of Accuracy that Grinding-in is Unnecessary



In Fig. 1, a single-end machine is shown arranged for performing the taper-boring operation on the valve body, which is a bronze casting. The maximum diameter of the bore is 1 7/16 inches, and it tapers to about 1 inch in a length of 2 7/16 inches. A diamond tool is employed to obtain the high degree of smoothness required, the depth of cut being from 0.004 to 0.005 inch, and the feed 0.0015 inch. Twenty valves are finished every hour, ready to receive the tapered plug.

During the operation, the valve body is rotated at a speed of 1200 revolutions per minute. The boring tool is carried on the double cross-slide which is mounted on the table of the machine. The boring unit can be adjusted to any desired angle in the horizontal plane to suit various

jobs. A micrometer adjustment permits accurate settings of the boring-bar.

In loading the valve body into the fixture, a plug is inserted through the hole that is to be bored and into an accurate hole in the chuck, so as to locate the valve body accurately for the operation. After a clamping plate has been locked tight against the valve body, this locating plug is removed. In the boring operation, the table is fed hydraulically toward the left for boring the tapered seat, and then it is returned automatically to the starting position. However, before the return movement, a hydraulic cylinder on the carriage shifts the cross-slide sufficiently to back the boring tool away from the work and thus avoid dragging the tool over the finished surface. The tapered seat in the valve body is interrupted by a cored hole of considerable size. However, the cut is taken across this hole without difficulty, the edges of the hole being left clean and sharp.

The Tapered Surface of the Key is Interrupted on Both Sides

In Fig. 2, the same machine is shown being used for turning the tapered plug, which is also a bronze casting. It will be noted that a cored slot extends completely through the plug, thus making two interruptions in the tapered surface. In spite of this, a uniform taper of fine finish is obtained through the use of a diamond tool. The depth of cut is from 0.004 to 0.005 inch, the feed is 0.0015 inch, and the work-spindle speed 3000 revolutions per minute. Forty-two tapered plugs are finished per hour.

The same machine and boring equipment are used for the taper-turning of the plug as for the boring operation on the valve body, with the exception that the chuck used in the boring operation is replaced by a tapered arbor, which is screwed into the nose of the boring spindle for supporting the plug. The plugs come to the machine with one end faced, so that when the threaded end of the plug is screwed into the arbor, a flush fit is obtained.

In this operation, the work is rotated clockwise and the tool is fed along the back side of the work. The same tool relieving action is employed to prevent a draw-back line as in boring the bodies.

Taper Boring and Turning Five Pieces at One Time

A machine equipped with four taper-boring units and one taper-turning unit for machining cast-iron and bronze T-valves and their steel plugs and seats is shown in Fig. 3. Three boring units are mounted on the left-hand side of the carriage at an angle of 4 degrees relative to the work-holding spindles on the left-hand bridge of the machine. Different work-rotating speeds to suit the cast-iron and bronze valve bodies are obtained by using suitable pulleys in the drive to the individual work-spindles. The cast-iron valves are revolved at a speed of 1250 revolutions per minute, and the bronze valves at a speed of 1800 revolutions per minute. In machining either cast-iron or bronze valve bodies, the depth of cut is from 0.004 to 0.005 inch. The feed of the tungsten-carbide tools used in boring the cast-iron bodies is 0.002 inch, and the feed of the diamond tools used in boring the bronze bodies is 0.0015 inch.

On the right-hand side of the carriage fixture is a tool unit that taper-bores the steel valve seats, and a second tool unit that taper-turns the steel plugs. Both of these units can be adjusted to an angle of 15 degrees. The plugs and seats are revolved at a speed of 900 revolutions per minute by the units on the right-hand bridge. Tantalum-carbide tools are used for these operations, the depth of cut being from 0.005 to 0.0075 inch, and the feed 0.002 inch.

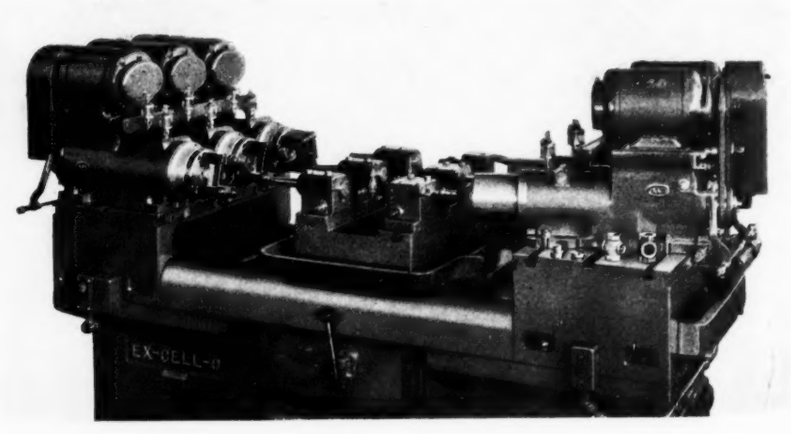
The valve bodies are bored at the rate of approximately eighty-three an hour, while ninety-five plugs and seats are produced an hour.

* * *

Industrial Exposition in Cleveland Next Summer

The machinery and metal industries will occupy the central position in a three months industrial exposition to be held during July, August, and September at Cleveland, Ohio, to celebrate the centennial of the incorporation of Cleveland as a city. The exposition is expected to feature exhibits from the industries in the Great Lakes region.

Fig. 3. A Multiple Precision Boring Machine Arranged for the Taper Turning and Boring of Valve Parts on a High-production Basis



Tool for Boring Large Spherical Cavities

By H. C. SEEGERS, West Reading, Pa.

The machining of spherical cavities generally requires the use of special tool equipment. While comparatively simple tools can be used successfully for small work, considerable care must be taken in designing and constructing a tool for machining spherical cavities in such work as the housings for heavy-duty, self-aligning bearings like the one indicated by the dot-and-dash lines in Fig. 1. The work-piece to be machined is clamped to the table of the machine and remains stationary while the spherical cavity *C* is machined by the special tool *A* shown in Figs. 1 and 2. One end of the boring-bar *B* is held in the machine spindle, by which it is driven, and the other end is supported by an accurately aligned bearing. A star-wheel and worm-gear arrangement serves to pivot the tool-holding arm *D* about the pin *E*.

The construction of the tool is shown clearly in Fig. 2. The housing *F* is fixed to the boring-bar *B* by taper pins and set-screws. The tool-holder *D* is pivoted in housing *F* and can be swung about pin *E*, as indicated by the dotted lines. The tool-holder is guided in the slot in the housing and the boring-bar to prevent vibration. The inside of the housing is protected from chips and dust by the two guards *G* attached to arm *D*. These guards are free to move in the slot in the housing. The felt strips *H*, in contact with guards *G*, serve as seals.

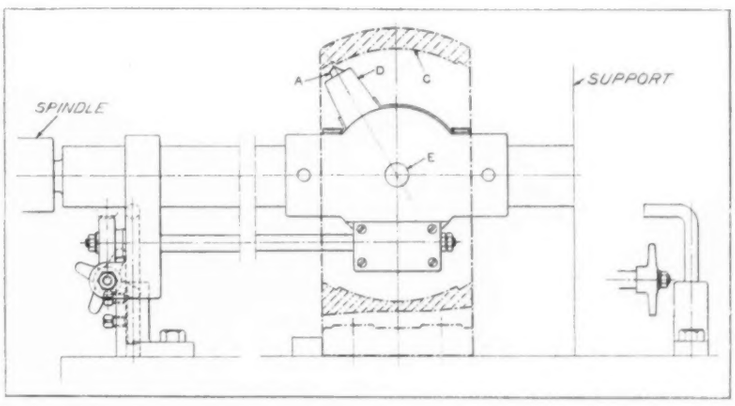


Fig. 1. Special Tool Set-up for Boring Spherical Cavity C in Heavy-duty, Self-aligning Bearing Housing

The feed is transmitted by the star-wheel *K* on a short shaft having a single-threaded worm which meshes with a worm-wheel *N* on the end of shaft *J*. Shaft *J* has a double-threaded worm *I* that meshes with a worm-wheel sector on one end of arm *D*. The star-wheel *K* is actuated by hand, or, when in operation, by the stationary stud *L*. Both worms are of 10 diametral pitch. The single-threaded worm in mesh with worm-wheel *N* has a lead of 0.3142 inch. The double-threaded worm *I* has a lead of 0.628 inch. The feed per revolution of the star-wheel is computed by the formula,

$$\text{Feed} = \frac{\text{Lead of worm } I \times \text{leverage of arm } D}{\text{Number of teeth in worm-wheel } N}$$

in which the leverage $= 5 \div 2 = 2.5$; number of teeth in $N = 20$; and lead of worm $I = 0.628$. Thus,

$$\text{Feed} = \frac{0.628 \times 2.5}{20} = 0.0785 \text{ inch per revolution}$$

As the number of fingers on the star-wheel can vary from three to six, the actual feed per revolution of the boring-bar equals 0.0785 divided by the number of fingers on the star-wheel used. The feed for star-wheels with three to six fingers would be as follows: Three fingers, 0.02616 inch; four fingers, 0.0196

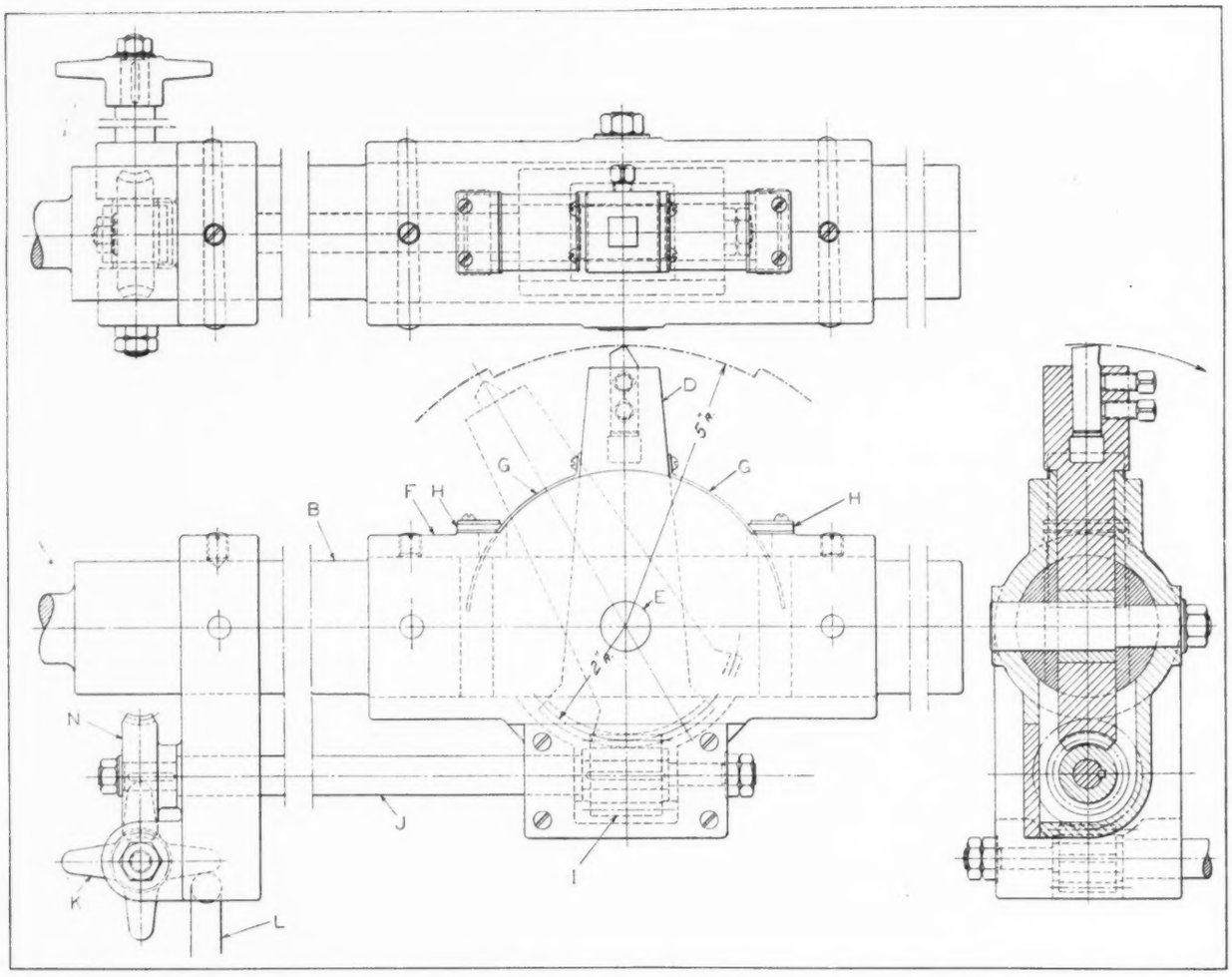


Fig. 2. Constructional Details of Spherical Boring Tool Shown in Fig. 1

inch; five fingers, 0.0157 inch; and six fingers, 0.01308 inch.

Any change in the length of the tool-holder or tool adjustment for boring different diameters will, of course, vary the feeds. The four different star-wheels mentioned, however, enable the operator to obtain the required feeds. The boring-bar is located at the center of the work and the tool is set to the correct position by means of a height gage. After the tool has been set to bore the work to the required diameter, the feeding stud *L*, Fig. 2, is adjusted to make contact with one finger of the star-wheel. The tool is moved to the position shown by the dotted lines before the operation. The work can then be mounted on the table.

Disk-Piercing Die with Automatic Indexing Mechanism

By GEORGE L. PYRITZ, Indianapolis, Ind.

The tool described here is for piercing a series of holes near the outer edge of thin steel disks used for ends or rims of squirrel type blower fans. Three features of this tool are of unusual interest. They are first, the indexing mechanism; second, the manner in which the stripping load is taken, independently of the sub-press frame; third, the universality of the tool, which permits punching disks of a great range of diameters and number of holes, and positioning the holes to suit different lay-outs.

The indexing mechanism consists of a worm-wheel, which drives the disk to be pierced through a gear train. It is operated by means of a chain and sprocket wheel mounted on the crankshaft of the punch press which drives the sprocket wheel *F* and worm-wheel *G*. The worm-wheel meshes with a standard involute-tooth spur gear *H*. The helical thread of the worm does not make a complete revolution, but extends through an angle of 270 degrees only. In the remaining 90 degrees, the teeth are truly radial and of involute rack tooth form.

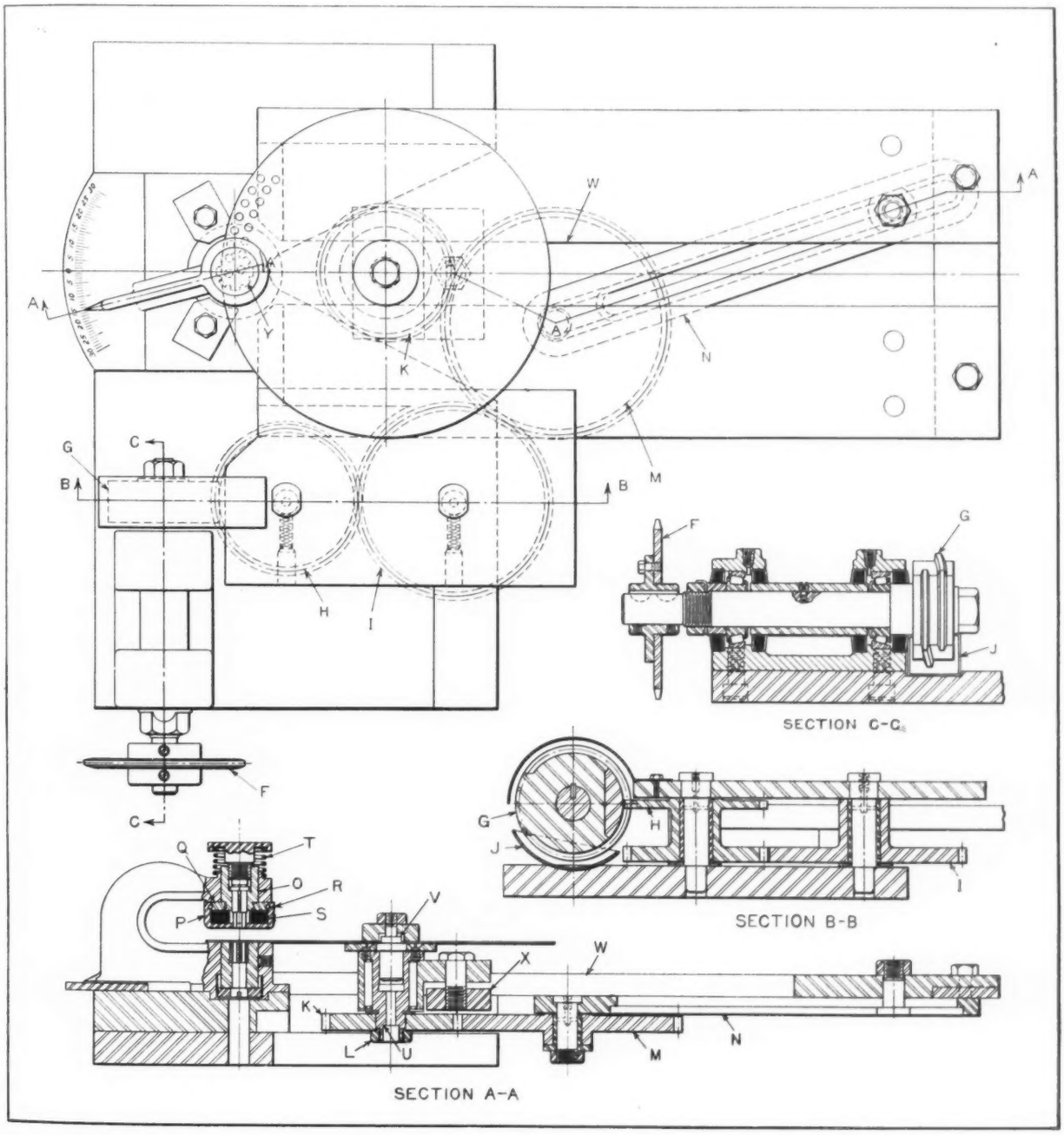
Thus for 90 degrees of every revolution of the worm there is a dwell in the movement of the gear train and disk. This represents, on a punch press of 3-inch stroke, a movement down and up of the punch of about 7/16 inch, and allows the punch to enter the disk and withdraw while the disk remains stationary. Due to the tooth form of the worm-wheel and the fact that the entire gear train is set

up without backlash, the disk is locked securely during this dwell period.

Inasmuch as the disk is rotated at uniform speed for three-fourths of the total punch movement, the movement of the disk is distributed over as long a period of time as possible. This reduces to a minimum the tendency of the disk to rebound at every dwell period, which is a difficulty that must be overcome in all indexing mechanisms of this type.

The driven gear *H* and idler gear *I* are mounted on eccentric spindles, which allows them to be adjusted to take up backlash. Lubrication for the worm-wheel is supplied from the reservoir *J*. The gear *K* is a spline fit on the spindle *U*, which carries the disk, and is readily taken off for a change in set-up by removing the nut *L*. After the change is made, the idler gear *M* is swung into mesh, and the arm *N* tightened to eliminate backlash. As the disk is advanced an amount equal to one tooth for every revolution of the crankshaft, it is only necessary to use a gear *K* having a number of teeth corresponding to the number of holes to be punched in the disk. For instance, when sixty sets of holes are to be punched, a gear *K* with sixty teeth is used.

In the sub-press assembly is the punch-holder *O*, on which is mounted the stripping unit. The stripping unit consists of washer *Q*, cup *P*, and rubber *S*. The stripping force, which is in an up-



Die Equipped with Indexing Mechanism for Piercing a Series of Holes Near the Outer Edge of Disks

ward direction, is taken entirely on the washer *Q*, and pulls the punches out. The reaction, which is a downward force, is taken on the cup *P* and holds the disk down. The function of the spring *T* is merely to hold the weight of the punch assembly. It does not assist the stripping action in any way. Thus, the sub-press frame is always free from any stress due to stripping. It only serves as a guide to keep the punches and dies in line.

The pilot *V* for the work is secured by four screws, and can easily be changed to fit disks having center holes of different sizes. This spindle assembly is mounted in a block which slides in the slot *W* and is held in position by a clamp *X*. With this arrangement, disks ranging in diameter from 4 to 30 inches can be pierced.

The alignment of the punches and dies is maintained by the splined punch-holder and die-holder at *Y*. Where sets of two holes are punched, the angle of a center line through both holes with respect to a radial line is set by the pointer at the rear of the sub-press frame. The sub-press frame is located in a counterbore in the base and held down by two clamps.

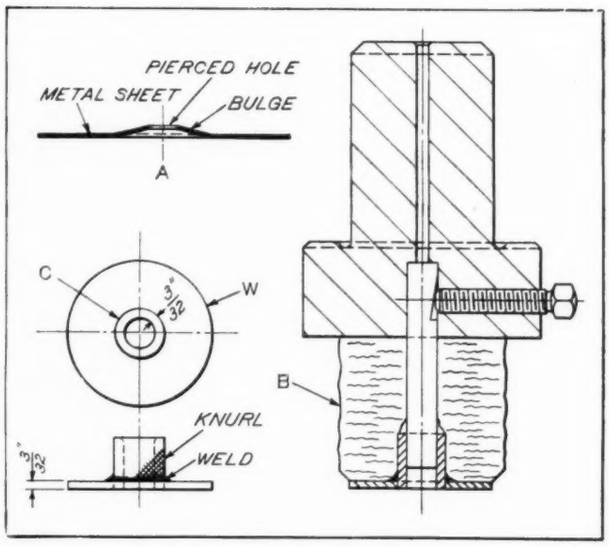
Some disks require rectangular holes to be pierced, others require holes of different size and spacing. For each of these conditions, a complete sub-press assembly is provided. To make a change in set-up, only three simple operations are necessary: First, the sub-press is set at the required angle; second, the proper indexing gear is mounted; and third, the disk-holding spindle is set to the correct center distance. This has proved to be a good production tool, and it is also adapted for making small lots and samples.

Metal-Faced Rubber Stripper for Piercing Punch

By WILLIAM STEUER, Tool Designer
Electric Service Supplies Co., Philadelphia, Pa.

A metal-faced rubber stripper, which has been found very effective in stripping sheet metal from punches without distorting the metal around the pierced hole, is shown in the accompanying illustration. In piercing sheet metal 0.025 inch or less in thickness, the metal is usually bulged, as shown at *A*, when stripped from the punch with a plain rubber stripper. This bulging is due to insufficient stripping pressure around the edge of the hole. Work distorted in this manner requires a flattening operation, in order to remove the bulge. With the metal-faced stripper, however, the sheet metal remains flat when stripped from the punch.

The metal facing consists of a steel collar *C* welded to a steel washer *W*. The collar *C* is knurled in order to secure the rubber stripper *B* more firmly to the collar. The hole in the rubber stripper is made under size in the conventional manner, so



Piercing Punch with Metal-faced Stripper

that it will adhere to the piercing punch. The collar *C*, being over size and knurled, will remain on the stripper. The view at the right shows the metal facing applied to a plain piercing punch. This device has been found invaluable when applied to gang dies, where a spring or fixed stripper is impractical because of the frequency with which the punches must be changed for piercing holes of different sizes.

* * *

Purolator Filters Used in Chain Manufacture

One of the largest companies manufacturing anti-skid chains for automobiles finds that by employing filters in the electroplating solution for the chain, it is possible to obtain a substantial saving in cost, a reduction in manufacturing time, and improved appearance.

The chain company dips its chains in a cadmium plating solution to make them rustproof. The chains are carried through a 1000-gallon tank of the solution on an endless conveyor. As this tank is open, the solution collects dirt from the air, as well as grease from the chains. Before the use of filters, this contamination caused a dull finish on the chain and occasionally left spots unplated or spots from which the plating chipped away. This necessitated the shutting down of the plating process at frequent intervals to replace the solution.

Engineers of Motor Improvements, Inc., Newark, N. J., makers of Purolator lubricating oil filters, suggested a bag type filter made from cotton with metal screen reinforcement. Such filters have been used successfully to filter the lubricant used in rolling aluminum sheets. The filter was successful with the cadmium plating solution, which is now kept clean. The filter has over-all dimensions of about 18 by 10 inches.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Over-Lubrication of Electric Motors

R. H. L.—We have been experiencing considerable difficulty with rotting and failure of the insulation in electric motors. Someone has told us that this may be due to bad lubrication. As these motors have always been well lubricated and given the best of care, we are at a loss to account for this condition.

Answered by the Editor of "Oil-Ways," Published by the Standard Oil Co. of New Jersey

These motors have been too well lubricated. Undoubtedly over-zealous application of lubricant has resulted in the lubricant's entering the motor and permeating the insulation. As mineral lubricants have a very deleterious effect on the insulation used in electric motors, it is only a matter of time before rotting and failure occur. Care in seeing that only the correct amount of lubricant is used should solve your problem.

Test Blocks for Furnace Temperatures

L. K.—In an article in February MACHINERY, page 350, entitled "What a Shop Executive Should Know About the Heat-Treatment of Cutting Tools," the following statement was made:

"While it is possible to control furnace temperatures without the use of thermo-couples, through the use of standard test blocks of high-speed steel, it is believed that it is far preferable to know the exact temperature, using the test blocks to check the pyrometer, if desired. These blocks are usually of about 3/4-inch square section. The furnace temperature is so adjusted as to bring the block to a semi-plastic condition in a predetermined time."

Will you kindly give us the names and addresses of firms that manufacture and sell these blocks?

Answered by R. C. Deale, Executive Secretary, Sub-Committee on Metal Cutting Data, A.S.M.E.

The test blocks mentioned in my article in February MACHINERY are not sold by any manufacturer. All that your correspondent need do is to purchase a bar of 3/4-inch square, 18-4-1 high-speed steel, and cut off small blocks about 1 1/2 inches long.

This method of controlling the temperature of a heat-treating furnace is not in general use. It was developed at a time when pyrometers were unreliable, and is not believed to be entirely satisfactory as compared with the use of two pyrometers—a working pyrometer, and a standard which is used to check the working pyrometer at intervals of approximately two weeks.

The test block method of controlling furnace temperatures was used particularly where the furnace temperature was deliberately kept appreciably above the desired temperature, and the tool was removed on a rising temperature. I consider this method somewhat dangerous, because of the difficulties which are encountered when the time that the work should remain in the furnace is exceeded. It is far better in the present stage of the art to harden with the furnace held at the desired temperature by the use of accurate thermo-couples and to keep the tool in the furnace sufficiently long to heat it throughout its thickness. The main difficulty with this method is the tendency to scale, or grain growth, which may make control of the furnace atmosphere also desirable.

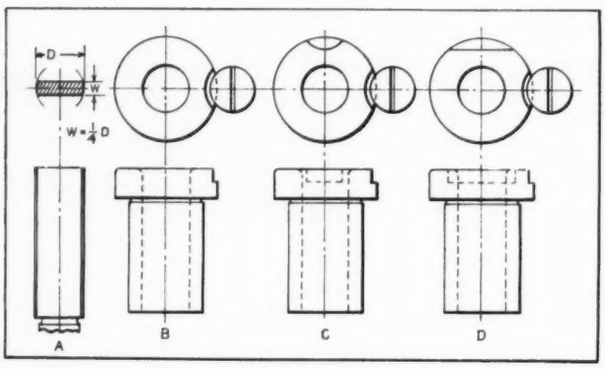
Steel Castings for Welded Structures

W. M. C.—What chemical composition should be specified for straight carbon steel castings that are to be welded to rolled-steel plates and structural shapes? It is desirable that the material be selected to facilitate the welding operations and give the assembled structure maximum uniform strength.

A.—Experience has shown that castings of the following composition can be successfully welded to steel plates and shapes: Carbon, 0.17 to 0.25 per cent; manganese, 0.50 to 0.80 per cent; silicon, 0.25 to 0.40 per cent; phosphorus, 0.06 per cent, maximum; and sulphur, 0.06 per cent, maximum. When properly heat-treated, steel castings of this composition may be expected to have the following physical properties: Yield point, from 30,000 to 45,000 pounds per square inch; tensile strength, 60,000 to 75,000 pounds per square inch; elongation in 2 inches, 35 to 22 per cent; reduction in area, 55 to 30 per cent; and Brinell hardness, 115 to 160.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Drill Bushings and Gage for Detecting Wear in Bushing Holes

Lengthening the Life of Drill Bushings

The spindle of a drilling machine or drilling head is subjected to deflection under the strain of cutting, and as a result, the drill is pressed against the side of the hole in the bushing, wearing it out of round. A worn bushing which permits a plug gage 0.003 inch over size to enter may require the hole to be enlarged as much as 0.012 to 0.015 inch.

A plug gage *A*, relieved or cut away as shown in the accompanying illustration, should be used to determine when the hole in a drill bushing is larger than permissible for the accuracy required. A plain removable drill bushing of the conventional commercial type is shown at *B*. An additional locking screw recess is shown in the bushing illustrated at *C*. This additional recess permits the bushing to be revolved a quarter of a turn when it becomes worn excessively on one side so that a new wearing surface is presented. A stock drill bushing with a flat ground on the flange to provide a step shoulder for the locking screw is shown at *D*. Many bushings that are not up to the size required for very accurate work may be salvaged by grinding the shoulders and relocating them in the fixtures.

Flint, Mich. W. G. HOLMES

Making Black-Line Reproductions of Blueprints

When a reproduction of a blueprint is required for publication purposes, the usual procedure is to make a new drawing or tracing of the blueprint in black ink on white paper. This is usually expensive. In fact, reproductions of machines or machine parts are often omitted in cases where they are needed, simply because of the cost of preparing copy for the cuts.

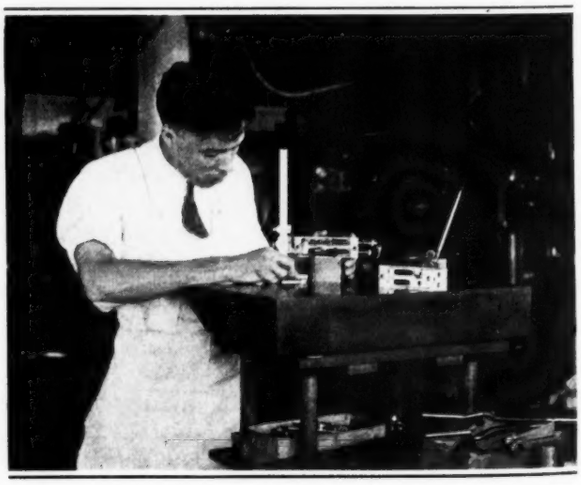
The writer has employed a comparatively inexpensive method in reproducing blueprints which can be used in such cases. It consists simply of using a photostat of the blueprint as copy for the engravings or cut. Photostats, which have sharp black lines on a white background, are suitable for this purpose and can be obtained at a nominal cost.

Newark, N. J. W. F. SCHAPHORST

Toolmaker's Surface Plate Set at Convenient Height

In the majority of cases, a toolmaker's surface plate is set on the bench, where it is too low for convenience unless the worker sits down, which is not always satisfactory. At the plant of the White Sewing Machine Co., Cleveland, Ohio, surface plates are set at a convenient height, 50 inches from the floor, by mounting them on legs made of ordinary iron pipe. Such a plate permits the toolmaker to stand conveniently at his work when making close readings with a height gage, as shown in the illustration.

Cleveland, Ohio FRED B. JACOBS



Surface Plate Set 50 Inches from Floor for Use while Standing

How Can America Regain Prosperity?

In His Presidential Address before the American Society of Mechanical Engineers, Ralph E. Flanders, with His Accustomed Clear Logic, Pointed to the Road that Industry and Labor must Follow to Maintain a High Standard of Living in America. This Article is an Abstract of His Address

NEW Pioneers on a New Frontier was the subject of the presidential address by Ralph E. Flanders, president of the American Society of Mechanical Engineers, delivered before the Society December 4. In this address, Mr. Flanders pointed out that the unprecedented development of American industry and agriculture during the past century was due very largely to the fact that there was always a new geographical frontier which gave unlimited opportunity to enterprise—to capital and labor alike.

This geographical frontier no longer exists. Present business conditions are closely connected with its disappearance. Why not recognize the fact? Instead of recognizing this, however, we have built up false and inadequate theories of "over production," in spite of the fact that we have never had a decent general standard of living in this country; of "technological unemployment," when on technology alone can we found our hopes for the higher standards of the future; of "over investment," when an adequate provision of goods and services to the mass of our fellow citizens requires larger and more efficient productive facilities than we have ever dreamed of. All of these explanations and many more are shallow and inadequate.

We Are at the Cross-Roads—which Course Shall we Choose?

Now two courses are open to us. We can readjust our social, political, and industrial institutions to a future of limited opportunities; or we can find an equivalent for the lost frontier—an equivalent that will open up new opportunities for men and enterprise.

For the time being, we seem to be making the first and poorer choice. In some directions deliberately, and in others by indirection, we are slowing down our production of goods and services. In place of a confident advance toward business risk and personal adventure, we are all playing safe—business men, workers, farmers. We are at this moment organizing a new world of restricted production, restricted human enjoyment, and restricted opportunity for the coming generation. We have chosen to play the lesser part.

We need not do this and we must not do it. For the effective equivalent of the old physical frontier lies ready at our hands for our occupation, development, and enjoyment. That frontier lies so close at hand that it escapes our notice. Its separate features are so familiar to us that we have missed its significance as a whole. For the new frontier is not a distant physical region; it is an ever-present social possibility. *This new frontier is a greatly raised standard of living for the mass of our fellow citizens.*

A higher material standard of living does not mean higher wages, higher salaries, or higher dividends. It does not mean higher prices for goods or services—least of all does it mean restriction of output. It does mean more and more goods and services at lower and lower prices relative to incomes.

It is Possible for All Able and Willing to Work to Enjoy a Higher Standard of Living

Let us first consider whether a higher standard of living, defined in these terms, is physically possible. Next, let us see whether, if attained, it can take the place of the lost frontier in furnishing opportunity for youth and for capital. Finally, if these inquiries lead to favorable conclusions, let us see what it is that prevents our occupation of this new frontier, so that we may remove the hindrances and proceed with our new social advance.

There can surely be no question as to the physical possibility of a rising standard of living. We have the material resources required. The very abundance of our coal fields, oil wells, and fertile soil have embarrassed our clumsy institutions until we have imagined abundance to be a curse instead of a blessing. To obtain the materials we need and do not have, there are ample stores of native products for exchange in the markets of the world.

Finally, years of experience have produced in this country business and technical experience directly adapted to the production and distribution, on a large scale, at low cost, and with minimum human effort, of a rich variety of desirable goods and services. The rising standard of living is physically possible.

We seek more and better goods and services at less relative cost. This can only be effected to the desired degree by both expansion and refinement

of our productive machinery and processes. The expansion of industry will call for more and more workers. The needed expansion and improvement of production will call for more and more investment. Only by this expansion of operations and revival of investment can we simultaneously produce more and better goods and services, distribute them more widely, do so at a less relative cost, and employ more men in the process at a number of working hours per week which tends to decrease rather than increase. All other programs fall short of this complete solution.

We have made good progress toward an ever rising standard of living in the past, but in recent years our forward movement has been checked, and we have even been forced backward from our goal. The causes of our trouble have not been single, but many. Of the many, however, two are of such overshadowing importance that it is folly to disturb ourselves about the minor difficulties until we have found means of surmounting these major ones. In fact, we cannot even see the other problems clearly until these two have been solved.

We Must Recognize that Restricted Output is Not the Road to a High Standard of Living

The first obstacle is a false idea, and it is the more dangerous from being held by a great majority of the population of the country. Business, labor, and agriculture account for almost the whole body of persons engaged in providing a high standard of living; and all three of these groups are imbued with this false idea and strive to make it effective. That false idea is that the interests of each separate group are best served by control or restriction of output and by maintenance or raising of prices.

Industry has long been fascinated by the possibility of understandings between competitors which lead directly or indirectly to price and production control. Some industries have, indeed, been so "successful" in coming to agreements that they have encouraged outside competition and quite evidently defeated their own purposes.

Labor-union policy has been identical with business policy, but since the commodity dealt in is labor and skill, the fallacy is expressed in somewhat different terms. Labor-union policy seeks "shorter hours and higher wages" without any expressed or discernible limit; and some unions, like some businesses, have been so "successful" in this policy that their members are idle for months and years when other workers are profitably employed.

Agriculture has long looked with envy on the "success" of business and labor in carrying out this false idea, and at last it too has its chance, under the AAA, to limit production and raise prices. It too is meeting with the "success" of lost foreign markets, stimulated foreign competition, and actual importation of products that our farmers are well able to supply.

When business, labor, and agriculture hold the same beliefs, be they true or false, we must not be surprised if the administration hastens to embody those beliefs in the law of the land. This was done, and as a result we had AAA and NRA. But legislation cannot purge a fallacy of its folly. These two institutions together lead to a universal condition of less goods at higher prices. But our goal of a higher standard of living requires more and more goods at relatively lower prices. The governmental policy is false. It leads away from our goal.

Speculation is Our Second Great Obstacle to Economic Well Being

The first obstacle, then, is in the nature of a drag or brake or a heavy load to be carried. The second has more the nature of a recurring catastrophe which, when it occurs, not merely retards our advance, but stops it completely. It not merely stops it, but throws us backward and destroys the very mechanism of progress, so that we must spend years in repairing it before we can regain our lost ground and resume our advance. This second obstacle is the periodic onslaught of speculative frenzy to which our social organization is subjected. We should clearly understand what we mean by "speculative."

From time to time the business world, discouraged with the meager return of normal business, looks about and discovers lying ready at hand a marvelous mechanism which promises to work to a most attractive end. Instead of finding in his hands at the end of the year only the small profits of this year's business, this mechanism promises that the business man may hold in his hands to use or spend and enjoy *now*, not only the profits of this year, but next year's profits as well—the profits of five years ahead—the imagined profits of future generations. This mechanism is the speculative market for securities, real estate, and commodities, with the financial mechanism to which it is geared. The endeavor to realize far future profits by the use of this mechanism is "speculation" in the sense in which we are using the term.

When the professional speculators are joined by thousands of business men, and finally by the general public, in the operation of this mechanism, it does seem to work; but it is in appearance only. There on is mechanism that will reach into the future and seize the profits of years not yet born.

Speculation has Fostered Debt, and Industrial Indebtedness Puts the Brakes on Progress

That volume of indebtedness—that source of fallacious wealth—is an incredibly flimsy and fantastic structure when we reach the end of a protected speculative boom. It finally becomes evident to every one that the future profits on which present prices are based can never be realized. When that becomes evident, prices fall and debts become due.

And then, for long months and years, every cent of savings, every mite that can be spared from the bare expenses of existence, must be devoted to the liquidation of that indebtedness. These sums are lost to purchasing power, and these months are months of destruction and defeat. The damage must be painfully repaired before we can again resume our progress toward the new social frontier, the raised standard of living.

We have struggled with these two obstacles for generations, and they have grown stronger. What hope is there that we will ever control or overcome them? The prospect for sanity and intelligence in these matters looks brighter than at any time in the past. We have done much thinking. Experience has brought to us bitter lessons. Some of them we have learned.

One Great Industry has Set an Example Worth Following

We have, for instance, one example before our eyes of an industry that has never for a moment worshipped the false gods of production control and raised prices. The automotive industry has always been willing to submit to severe competition, and consequently has year by year built more and more and better and better cars and sold them for lower and lower prices. In further consequence, it has created the greatest increase in employment and payroll dollars and is the most prosperous of any of our great industries. It has made the greatest contribution to industrial recovery. Other industries are taking notice.

In the effort to re-establish a sound basis for a higher standard of living, industry must lead the way. We cannot expect labor or agriculture to do so. The prosperity that will come to industry as a whole in so doing will so directly increase the demand for labor and for agricultural products that the artificial methods hitherto applied by these two groups will be clearly seen to be the hopeless proceedings which in reality they are.

It must be clear to all that engineers have a particular interest and responsibility in these matters. We cannot remain inactive and see the choice made for us.

If, faced with the disappearance of the physical frontier, we cravenly resign ourselves to accepting that fact as final, and key our national policy and our national hopes down to that dismal decision, there will be little future for the engineer. There will be fewer of us, and our services will be of a subordinate order.

If, on the contrary, we make the more courageous decision to replace the lost physical frontier with the new social frontier of the raised standard of living, then the engineer will come into his own.

We are faced with these alternatives—to retreat or to advance. Is there any doubt as to which the American people should choose? Nay, rather, is there any doubt as to which they *will* choose?

Oakite Products Increases Jobs by the Use of Machinery

During the week beginning December 9, Oakite Products, Inc., New York City, manufacturers and distributors of cleaning materials for all industrial purposes, held a sales conference in New York City attended by the company's sales representatives from all over the United States and Canada, numbering upward of seventy-five men. Sales conferences were held throughout the week at which a great number of papers were read by the field men, relating to a variety of applications of Oakite products in industrial cleaning.

Wednesday evening, December 11, the company gave a dinner to the representatives, at which were also present the company's officers and a number of invited guests, including members of the technical press. On this occasion, D. C. Ball, president of the company, referred to a matter of unusual interest bearing upon the frequently reiterated charge that improved machine equipment causes unemployment. He mentioned that some twenty years ago, most of the work of preparing and compounding the company's products was done by hand labor. Today modern machine equipment is being used to an extent that makes it possible for one man to produce as much as was formerly produced by ten.

Here obviously, then, is a case where the machine has cut down the number of jobs. Not so! The savings due to the use of improved equipment have been passed on to industry and the general public in the form of lower prices, which, in turn, has increased the demand for the company's products to such an extent that, although modern machinery has made it possible to produce as much as formerly with but one-tenth of the labor, *four times as many men are employed*, because the output of the company is forty times as great; and what is more, this larger force is employed at double the wages per man, compared to twenty years ago.

A similar comparison might be applied to a great many industries. Take the automobile industry, for example. When about twenty-five years ago the number of automobiles built in this country reached the hundred-thousand mark, many believed that the market was saturated and that the annual output of the industry would hardly exceed that figure in the future. Yet, in 1935, over 4,000,000 cars and trucks were produced—again forty times the output of the earlier date; and the industry employed at least ten times as many people.

Gas Furnaces for Forging Plants

Four Gas-Fired Forging Furnaces Used by the Columbia Tool Steel Co. Have Proved Their Value in Economy of Operation and Improved Product

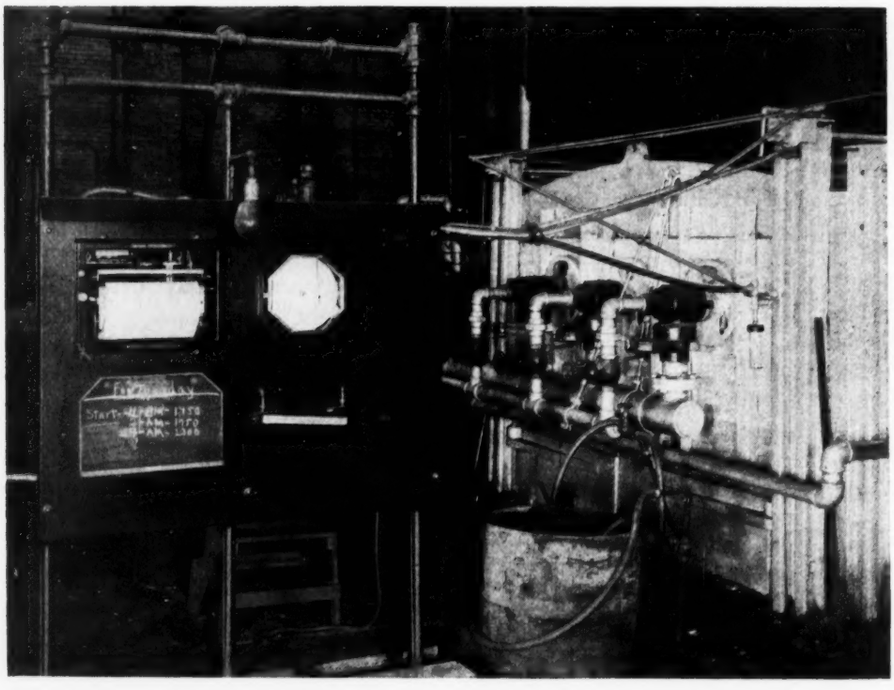
An improvement in the quality of the finished product, coupled with a decreased scale loss, is the result recorded in the operation of completely controlled gas-fired furnaces in the tool-steel forging plant of the Columbia Tool Steel Co., Chicago Heights, Ill. Following the first installation, three additional furnaces were converted to gas-firing, and a complete conversion of the plant to the use of gas is in prospect as a result of the successful operation of the first furnaces. The installations were made by the Mahr Mfg. Co., Minneapolis, Minn., under the direction of Robert G. Guthrie, chief metallurgist of the Peoples Gas Light & Coke Co., Chicago, in whose laboratory the preliminary research leading to the installation was conducted. The installation now includes four furnaces with hearths up to 16 feet in length and 7 feet in depth, having loading capacities up to 20,000 pounds per charge.

The work of conversion was comparatively simple. The insides of the furnaces were redesigned and rebricked, flue vents were installed in place of the stacks, and the fireboxes were bricked over. Each furnace was equipped with three Mahr low-pressure, sealed-in burners, each having a capacity of 2100 cubic feet of 1000 B.T.U. natural gas per hour. Air is supplied by individual blowers for each furnace.

The important feature about the installation is the control. Each furnace is equipped with two-position gas and air mechanical positive proportioning valves, with mechanical linkage and electrical operation. In contrast with traditional practice, the control instruments are set on an especially mounted control board close to the furnace and in full sight of the hammer crew, instead of being mounted in some other part of the plant on a central control board.

In addition to the usual recording temperature controller and gas and air regulating valves, the controls include a continuous gas-analysis recorder for each furnace, furnace pressure gages, and gas pressure regulators.

The crew foreman himself determines the heating program for any given charge. A slate is provided on which he lays out a twenty-four-hour program. A typical program, for instance, might run as follows: 11 P.M., set for temperature of 1450 degrees F.; 3 A.M., set for temperature of 1950 degrees F.; 5 A.M., set for temperature of



Forging Furnaces at the Columbia Tool Steel Co.'s Plant in Chicago Heights Converted for Gas-firing. Showing to the Left Recording Temperature Controller Mounted Adjacent to the Furnaces

2300 degrees F.; work-starting temperature, 2200 degrees F. At the hours designated, the night men set the temperatures on the recording temperature controllers, and the hammer foremen can satisfy themselves by a glance at the recorder that the program has been followed and that the material is ready for work. This practice not only assures accurate temperature control, but makes possible a controlled heating rate, with definite starting and finishing maximum and minimum temperatures.

By controlling the furnace atmosphere, decarburization of the surface of the forgings has been reduced by two-thirds, and scaling has been reduced by three-fourths, compared with former practice. The scale that comes off at the first hammer blows is paper-thin, reducing the scale loss to a minimum. Previous losses from ingots to finished bars have run as high as 9.4 per cent.

Another advantage lies in the uniformity of the product from heat to heat, from day to day the year around, because of the controlled atmosphere of the furnaces and the freedom from outside variable factors. For example, the fact that there is no stack in connection with the furnaces, and therefore no inflow draft around the furnace doors, aids in the uniform heating of the billets from one end to the other, and in obtaining consequent uniformity of the product.

The furnace is entirely independent of outside weather conditions which often cause difficulties in the operation of furnaces depending upon stack draft in their operation. A curtain of air is provided by blowers which direct a thin sheet of air upward in front of the furnace doors to protect the workmen. The working conditions for the hammer crew are improved, since there is no smoke, greater cleanliness, and a cleaner atmosphere for breathing.

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Influence of Manufacturing Requirements on Tool Development

In tracing American machine tool development from the most primitive down to the most modern designs, it will be noted that there is a very close relationship between improvements in metal-working tools and the introduction of certain of the more important inventions. For example, the invention of the steam engine, textile machinery, the bicycle, the motor car, and various other universally used forms of mechanisms have had a direct influence upon the development and design of various classes of tools.

Although it will never be possible to write a complete history of the origin and development of the basic metal-working tools, owing in part to lack of authentic records and also to the independent efforts of different inventors in designing tools of the same class, nevertheless it is evident that if a complete history were possible, it would cover the close relationship between product and equipment.

Barber-Colman Single-Position Hob Patents

On page 119 of October MACHINERY, in the article entitled "Laying Out Hobs for Spline Shafts," the paragraph starting "The fillet at the root may be practically eliminated . . ." describes the laying out of a hob known as the Barber-Colman single-position hob, which is fully covered by patents owned by the Barber-Colman Co., Rockford, Ill. The patents involved are No. 1,760,125 dated July 31, 1931, and No. 1,844,947 dated February 16, 1932. The hob is illustrated on pages 52 and 53 of the Barber-Colman Catalogue J. Attention is called to this fact because the using of hobs laid out as described would constitute an infringement of the Barber-Colman patents.

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Nickel Alloy Iron for Gears

D. W. Diefendorf, of the Diefendorf Gear Corporation, Syracuse, N. Y., mentions that cast iron is fast regaining popularity as a material for gears, largely because of the use of nickel alloyed with gray iron. Better foundry practice, better metallurgy, and a better knowledge of the physical properties required in gear materials make it possible today to produce cast iron that is far superior to that available five or ten years ago.

The application of nickel alloy iron to gearing problems may be divided into two classes; namely, its use to replace gray iron gears which do not have the required strength and, therefore, frequently fail through breakage; and the use of alloy iron in new gear drives designed with a view to minimizing tooth loads, increasing wear values, and obtaining low costs. It is for this second application that the new alloy irons are particularly valuable.

The Diefendorf Gear Corporation has used nickel alloy iron for gears with great success. In a 2 per cent nickel iron, the tensile strength is 75 per cent greater than that of ordinary gray iron. The Brinell hardness is around 220, as compared with 160 for ordinary gray iron.

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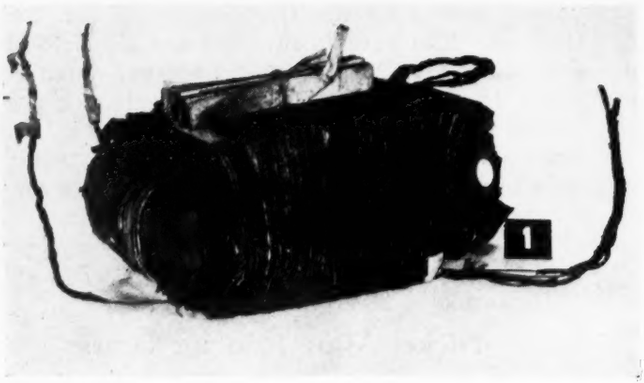
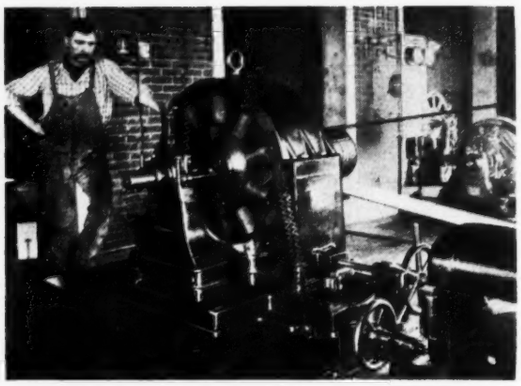
Cost of Operating Business Automobiles

The Metropolitan Life Insurance Co., 1 Madison Ave., New York City, through its Policyholders' Service Bureau, has published a booklet entitled "Controlling Costs and Operation of Business Automobiles," that contains a wealth of information on the cost and maintenance of automobiles used for business purposes by service men, salesmen, etc. It contains a record of the experiences of fifty-three companies located in all sections of the country and operating under a variety of conditions.

Westinghouse Electric Celebrates Fiftieth Anniversary



This Transformer was Part of the First Practical Installation of Alternating Current Made by George Westinghouse in 1885 at Great Barrington, Mass.



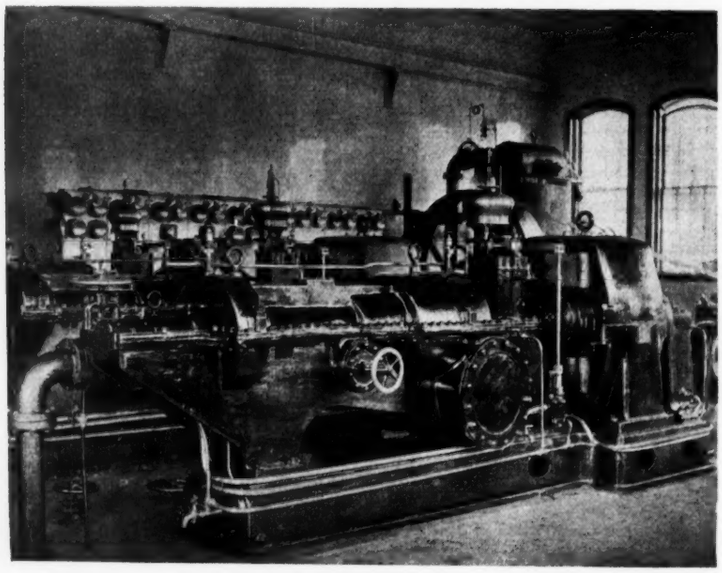
This is the First Practical Alternating-current Generator Built by the Westinghouse Company in 1886

ON January 8, 1886, the Westinghouse Electric & Mfg. Co. obtained its charter. Thus the company has just rounded out its first half-century of activity. The growth of the company during these years is well known. Its pioneering in the electrical field in America is also a matter of record, although it may not be generally known that in many branches of the electrical industry, Westinghouse brought out the first equipment of its kind.

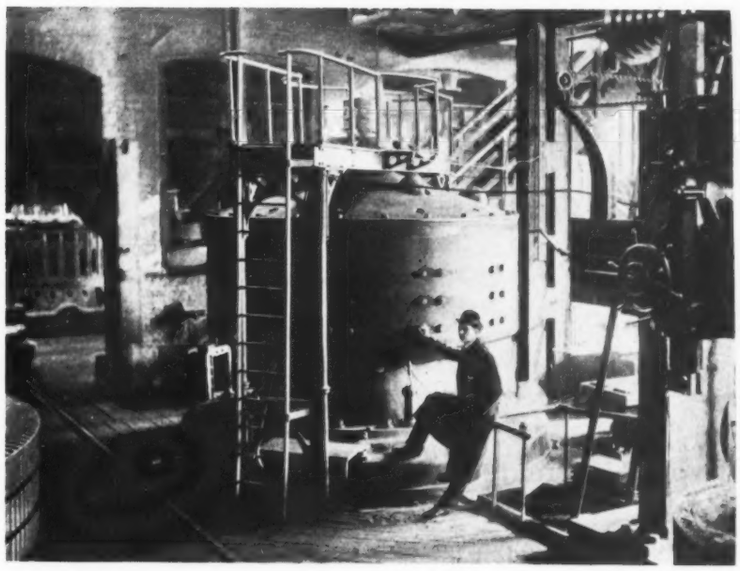
Even before the founding of the company, George Westinghouse—in 1885—developed the first practical electrical transformer. In 1886, the company placed the first alternating-current generating station in operation. In 1888, it introduced the first alternating-current induction motor, and in the same year, built the first meter for measuring alternating current. In 1895, the Westinghouse company installed the first Niagara Falls power plant, and in 1899, built the first commercial steam turbine generator unit.

The first long-distance alternating-current power-transmission line was installed by Westinghouse at Telluride, Calif., in 1891. In the same year he built a 10,000-volt transmission line from San Antonio Canyon to Pomona and San Bernardino. Among other early developments was the introduction in 1891 of the first single-reduction railway motor, setting a type for subsequent practice. Public attention was focussed on the company in connection with the World-Columbian Exposition in Chicago in 1893, where the lighting was installed by the Westinghouse company; this was the greatest display of incandescent lighting that had been seen anywhere in the world up to that time.

The company's contributions to the electrical industry and to power-plant development since the turn of the century are more generally known. These devel-



America's First Commercial Turbo-Generators—Three 400-kilowatt Sets Built in 1899. Note the Touch of Machine Tool Design in the Beds



This Niagara Generator, Built in 1895, is One of Several of 5000 Horsepower Each. They were Five Times Larger than Any Other Alternating-current Machines Previously Built. This was the Beginning of Large Power Plants. Incidentally, These Generators are Still in Operation

opments include the first large turbine-generator unit in America in 1900; a 50,000-volt transmission line to Butte, Mont., in 1903; the first electrified main rolls of a steel mill in 1905; a 140,000-volt transmission line in 1909; Micarta insulation in 1913; the electrification of railroads; the development of automatic sub-stations; and of Diesel electric drives for ships.

Of more popular interest is the fact that it was the Westinghouse company that originated radio broadcasting with station KDKA in 1920. At that time, the daily newspapers hesitated to publish the schedule of radio programs, considering the new development more or less of a fad. Today the publication of a complete radio program is one of the important assets of a daily newspaper, and some of them owe a large part of their circulation to that feature.

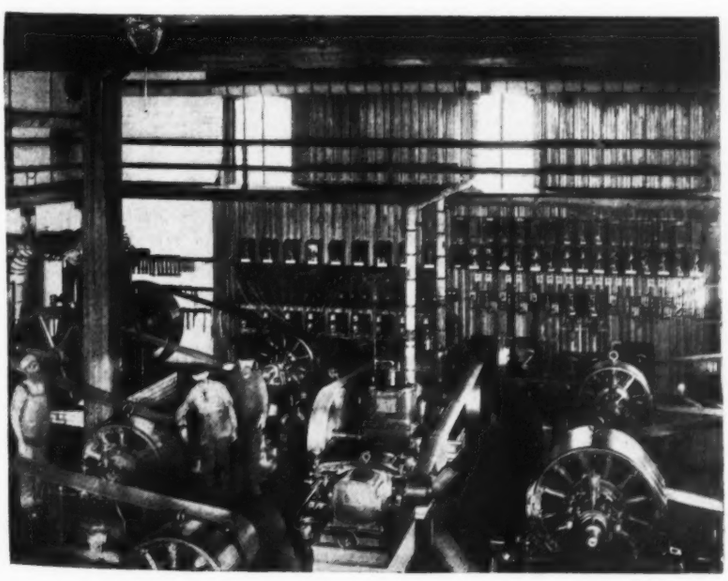
In the development of electric welding and in applications of the electric eye, the Westinghouse company has played an important part. It inaugurated, in 1926, the electric welding of buildings, thus starting what is almost equivalent to a revolution in many of the methods of building construction.

When the company was incorporated in 1886, it began manufacturing operations in a small factory building known as the Garrison Alley plant in downtown Pittsburgh. Its first payroll had 200 names, and its sales during the first nine months of operation amounted to $142,000. Its first catalogue listed thirteen items and its sales representatives were located in five cities in the United States.

Today the Westinghouse company employs approximately 40,000 people—in its peak year it employed 50,000. With subsidiary companies, it operates seventeen plants, and in a normal year, its sales reach upward of $180,000,000. It maintains sales organizations in 103 cities in the United States, with twenty-seven warehouses and thirty-six service shops. Its overseas sales are handled through representation in more than eighty countries. Its catalogues now list thousands of items, ranging from electric curling irons to electric locomotives and complete generating stations.

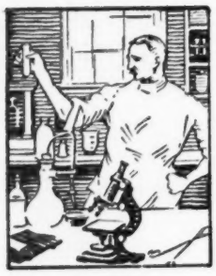
The first building of the present main plant of the company in East Pittsburgh was erected in 1895. Today, the Turtle Creek Valley at this point is filled with rows of buildings that extend for more than a mile.

Few organizations can look back upon a half-century of such outstanding achievements as the Westinghouse Electric & Mfg. Co.



An Early Alternating-current Power Plant Built by Westinghouse about 1888. Note the Switchboard Equipment Mounted on Wooden Panels

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Two New Phenolic Plastics that Meet Special Needs

A phenolic molding material that resists water to an unusual degree has been brought out by General Plastics, Inc., North Tonawanda, N. Y. Parts molded from this material, which has been designated Durez 75 series, are said to stand up for years under complete and constant immersion in water. Recent applications of this new material include a disinfecting device for telephones, in which a 50 per cent alcoholic solution is sealed in a Durez cylinder; toilet-tank valve assemblies and float balls; and containers for semi-liquids.

In many electrical applications of molded plastics and especially in the new high-tension automobile ignition parts, a much higher dielectric breakdown and dielectric fatigue are required than are obtainable in ordinary molding materials. To meet this demand, General Plastics, Inc., has developed Durez No. 2491, which is available in black, brown, and red. Rotors and coil caps for 1936 automobiles are being made from this material.

3200 Feet of Steel Tubing to the Pound

It would probably surprise many who have watched a physician use a hypodermic syringe to know that the delicate needle is a piece of seamless steel tubing produced from a solid steel billet in the regular manner and reduced to the required size by successive cold-drawing and annealing operations. Tubing for such usage is made by the Summerill Tubing Co., Bridgeport, Pa., as small as 0.006 inch bore diameter and 0.003 inch wall thickness. In this size, over 3200 feet of tubing are required to make a pound. High-carbon and Nirosta stainless steel are used in the manufacture of this tubing.

Needle tubing is made by the company on a regular manufacturing basis at the rate of thousands of feet a day in sizes ranging up to 0.120 inch outside diameter and 0.010 inch wall thickness. Small tubing is employed in a variety of applications besides hypodermic syringes. For example, cathode sleeves for radio tubes are made of pure nickel tubing having an outside diameter of 0.016 inch or larger and walls of from 0.0015 to 0.002 inch in thickness. Capillary tubes are made with bores from 0.007 to 0.010 inch. Tolerances of 0.0005 inch are maintained in the manufacture of these minute tubes.

Selecting Materials for Gas Engine Cylinders

According to a paper read before the American Foundrymen's Association by H. F. Allen of the Link-Belt Co., a review of the specifications of materials used in industrial engines shows that there is an increasing tendency to use nickel and chrome-nickel iron for cylinder blocks and heads, and of late the addition of molybdenum to the chromium and nickel is noted. The stability and freedom from growth of the molybdenum irons at the higher temperatures doubtless account for their increasing use.

In the case of Diesel engines and some of the larger gasoline engines, cylinder liners are made from alloy irons and heat-treated to a hardness of 400 Brinell. The longer life obtained from parts of such hardness is self-evident.

One of the most serious problems encountered in building internal combustion engines of any kind is grain growth. The extent to which dimensions of parts are sometimes changed by grain growth is almost unbelievable. One maker cites the case of two bars of iron, both exactly 10 inches long, that were placed in a furnace and heated for 300 hours at 1700 degrees F. One of the bars, a fair grade of chrome-nickel iron, grew 5/8 inch in length, while the other bar immediately adjacent to it grew only 0.0004 inch. The result of this test shows the reason why cracks occur in many manifolds, piston heads, cylinder heads, and valve seats.

In another case, considerable trouble was encountered with cylinders that developed cracks extending from the bore to the valve seat. Although no change was made in the design of the cylinder,

a change in material reduced the breakage to less than 4 per cent of what it previously was.

In cases where cylinder heads, particularly cylinder heads of Diesel engines, were made with very heavy sections in an attempt to overcome trouble from cracking, it was found that this remedy failed utterly, and the heads cracked more quickly than before. This was because the metal on the inside of the combustion chamber was exposed to terrific heat which developed surface cracks that quickly penetrated through the metal. The proper solution is the use of alloy irons that are not so readily affected by high temperatures.

Rubber Plays an Important Part in the New Automobiles

The modern automobile makes use of a great deal of rubber. For example, the Plymouth car, has more than 400 rubber parts, totaling over 40 pounds in weight. For the first time, it is stated, thick rubber shims are used between the body and frame to promote silent operation.

Cadmium-Nickel Alloy for High-Speed Motors

According to an article by Carl E. Swartz, of the Research Department of the American Smelting & Refining Co., which appeared in a publication of the International Nickel Co., the cadmium-nickel alloy developed to meet increased demands of high-speed, high-compression motors possesses some important advantages over ordinary babbitt.

This alloy, known as "Asarcoloy No. 7," has a Brinell hardness at 82 degrees F. of 33, compared with 24 for babbitt. At 390 degrees F., the Brinell hardness of the new material is 7, and that of babbitt 4. The yield point in tension of the cadmium-nickel alloy is 11,700 pounds per square inch, while that of babbitt is 8500 pounds per square inch. The elongation at 82 degrees F. is 19, compared with 10 for babbitt, and 111 at 390 degrees F. compared with 86 for babbitt.

The compressive strength of the cadmium alloy at 82 degrees F. is 21,800 pounds per square inch, compared with 14,000 pounds per square inch for babbitt. At 390 degrees F. the compressive strength of the cadmium-nickel alloy is 4400 pounds per square inch, and that of babbitt 2300 pounds per square inch.

Unlike most cadmium alloys, cadmium nickel is said to bond directly with steel, so that the same composition as is used for the bearing proper can be used for bonding. No chemical compound is formed at the bond, but the nickel penetrates the steel slightly, much the same as in welding nickel to steel.

Hot or Cold Materials Marked by Paint in Stick Form

Permanent markings can be made on any hard-surface material by a paint in stick form which can be carried around in the pocket and used as conveniently as a pencil. This paint, which is known as Markal, is made in two types—one for cold marking and the other for hot marking.

Cold-marking Markal can be used on all metals, such as structural steel, sheet steel, galvanized iron, etc., and also on glass, cardboard, lumber, and other materials. Hot-marking Markal can be used on steel shapes, forgings, castings, pipes, and billets. It marks clearly at any temperature between 300 and 1200 degrees F. It does not run or flow while hot and does not peel off after cooling. The marking is also weatherproof. This material is sold by Helmer & Staley, 2476 South Parkway, Chicago, Ill.

Alnico—A Permanent-Magnet Alloy Having Unusual Power

New fields of application for permanent magnets are said to be opened by a new alloy known as Alnico which has been developed by the General Electric Co., Schenectady, N. Y. Because of the power of magnets made from this alloy, small motors and various control devices hitherto operated by electromagnets can now be operated by permanent magnet fields at a considerable saving in cost.

Alnico has already been applied for a variety of uses, including blow-outs for relays, holding-in magnets for large switches, special timing relays, and various control devices. Magnets made of Alnico will lift about sixty times their own weight. The illustration shows a one-pound magnet sustaining a 60-pound radio cabinet.

The Simonds Saw & Steel Co., Lockport, N. Y., has been licensed to manufacture and sell magnets of the new alloy. Alnico contains iron, aluminum, nickel, and cobalt. It is usually cast and finished to shape by grinding.

A One-pound Alnico Magnet Holding Sixty Times its Own Weight

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

Small Tools

UNION TWIST DRILL CO., Athol, Mass. Catalogue M, containing 317 pages covering the complete line of tools made by this concern, including milling cutters, gear-cutters, hobs, twist drills, and reamers. In addition to tables of dimensions and prices, the catalogue contains information of value to users of these tools, such as suggestions on the proper use of milling cutters; tables of cutting speeds; tables for the sizing and cutting of gears; tables showing the cutters to use in cutting bevel gears; information on sharpening twist drills; feeds and speeds for high-speed steel drills; and much other valuable information.

Metal Cleaning

MAGNUS CHEMICAL CO., INC., 48 South Ave., Garwood, N. J. 213-page book entitled "The Metal Cleaning Handbook," comprising a handy guide for those interested in or directly concerned with metal cleaning. It covers equipment, methods, and materials, with practical suggestions for their use. Specific directions are given for cleaning various classes of metals, such as aluminum, brass, cadmium, chromium, die-casting metals, etc. A limited number of these books are available for free distribution among those engaged in metal cleaning who request a copy on a business letter-head.

Ball Bearings

FAFNIR BEARING CO., New Britain, Conn. Booklet entitled "Bearings in the Making," containing a collection of photographs showing the major steps in the manufacture of ball bearings, including the more important manufacturing and inspection operations. The steps illustrated cover the forging and machining of the rings, cold-forming of the balls, hardening, facing, grinding, matching, and inspection.

Power-Press Air Cushions

CLEARING MACHINE CORPORATION, 6499 W. 65th St., Chicago, Ill. Bulletin illustrating and describing several improved types of Clearing air cushions for power presses. Tables of specifications giving the maximum height of cushions for different piston diameters and draws are included, as well as other useful engineering data, such as capacity of crankshaft near bottom of stroke, approximate die clearance between punch and die, etc.

Rubber Products

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., 44 Townsend St., Passaic, N. J. Second edition of the company's general catalogue covering belting, hose, packing, molded goods, friction material, rubber coverings, abrasive wheels, etc. New bulletins are also available on the "Condor Compensated" low-tension rubber belt, Condor Whipcord V-belts and Condor Whipcord endless transmission belts.

Electric Furnaces

DETROIT ELECTRIC FURNACE CO., 825 W. Elizabeth St., Detroit, Mich. Combination handbook and catalogue for the foundry industry entitled "Modern Melting," containing general melting information, descriptions of the various rocking arc furnaces made by the company, and a section on auxiliary furnaces and foundry equipment, such as electrodes, refractories, circuit-breakers, pyrometers, etc.

Zinc Alloys

GRASSELLI CHEMICAL CO., INC., 629 Euclid Ave., Cleveland, Ohio. Service bulletin containing technical information on Grasselli "Bright Zinc." The booklet contains comparative data on the physical and chemical properties of zinc and cadmium, together with their respective rust protective properties, time required for electro-deposition, and relative costs for electroplating.

Inclinable Presses

NIAGARA MACHINE & TOOL WORKS, 637-697 Northland Ave., Buffalo, N. Y. Bulletin 58-E, illustrating and describing the new line of Niagara Master Series A inclinable presses and the improved line of Standard Series inclinable presses. A condensed tabulation of specifications, dimensions, capacities, and speeds of both plain and geared models is given.

Lubricants

PYROIL CO., 887 La Follette Ave., LaCrosse, Wis. "Review of Report on Lubrication Tests with Pyroil in Connection with Alloy Bearings," containing data covering fifty-four comparative tests, indicating that in all tests less wear was found when Pyroil was used. Graphs and diagrams are included to show the results of the tests graphically.

Cleaning Equipment

AMERICAN FOUNDRY EQUIPMENT CO., 555 Byrkit St., Mishawaka, Ind. Book No. 111 entitled "Wheelabrating," dealing with abrasive cleaning and preparation methods. The catalogue describes the Wheelabrator, a mechanical device for throwing abrasive by centrifugal and tangential force on products to be cleaned, such as castings or forgings.

Electric Motors

OHIO ELECTRIC MFG. CO., 5900 Maurice Ave., Cleveland, Ohio. Sheets Nos. 4, 5, 6, and 7 of loose-leaf Bulletin 212-B, giving dimensions of the various types of fractional-size motors made with standard frames; also sheets Nos. 10, 11, 12, 13, and 14 of Bulletin 211-A, giving dimensions of special designs identified with standard frames.

Speed Reducers

LINK-BELT CO., 2045 W. Hunting Park Ave., Philadelphia, Pa. Cata-

logue 1519, covering the Link-Belt line of single, double, and triple reduction herringbone-gear speed reducers, for large speed ratios and heavy and shock loads. Numerous typical installations are shown, with solutions of actual driving problems.

Stainless and Tool Steels

JESSOP STEEL CO., Washington, Pa. Circular describing Silverbond composite stainless steel—its advantages, methods of testing, fabricating, and welding, and applications. Circular giving information on the advantages, range of sizes, heat-treatment, and applications of Jessop Blue Stripe and Red Stripe composite tool steels.

Screws, Bolts and Nuts

PHEOLL MFG. CO., 5700 Roosevelt Road, Chicago, Ill. 1936 edition of this company's general catalogue covering screws, bolts, and nuts. The catalogue contains the latest price lists, American standard dimensional data, weight tables, and other information. It is provided with a thumb-index for convenient reference.

Roller Bearings

TIMKEN ROLLER BEARING CO., Canton, Ohio. Booklet entitled "The Application of Timken Tapered Roller Bearings on Engine Crankshafts," containing a non-technical discussion of the use of Timken bearings in gas, semi-Diesel, and full-Diesel engines. A list of sizes which have been built and are in service is included.

Gear Shapers

FELLOWS GEAR SHAPER CO., 78 River St., Springfield, Vt. Circular illustrating and describing the Fellows No. 6 hourglass gear shaper for cutting hourglass worms. The circular describes the principle of operation, methods of operating, methods of figuring cutting time, and electrical equipment.

Lathes

PRATT & WHITNEY CO., Hartford, Conn. Circular 419, illustrating and describing the important features of the Pratt & Whitney Model C lathe, which is made in 14- and 16-inch sizes for both heavy production work and tool-room precision jobs. Complete specifications for the two sizes are included.

Materials-Handling Machinery

PALMER-BEE CO., Detroit, Mich. Section 106 of General Catalogue 100, describing the bulk material-handling machinery made by this concern for use in elevating and conveying installations. This section of the catalogue deals specifically with chain type material-handling equipment.

Arc Welding Machines

HOBART BROS., Hobart Square, Troy, Ohio. Booklet entitled "A Trip Through the Most Modern Arc Welder Factory in the World," containing full-page illustrations of the various departments in this company's plant and of the machines and equipment used in building Hobart arc welders.

Molybdenum Alloys

CLIMAX MOLYBDENUM CO., 500 Fifth Ave., New York City. Booklet entitled "Molybdenum in Iron and Steel," briefly describing the advantages resulting from the addition of molybdenum to iron and steel, and the applications in which molybdenum alloys have proved of value.

Electric Trucks

EASTON CAR & CONSTRUCTION CO., 40 Holly St., Easton, Pa. Bulletin 81, containing a general description, as well as complete specifications, of the Types TL-4 and TL-6 electric industrial "Tier Lift" trucks, having capacities of 4000 and 6000 pounds, platform load, respectively.

Electric Equipment

JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill. Bulletin 13-1, illustrating and describing Janette rotary converters for converting direct current to alternating current. Folder illustrating Janette motorized speed reducers, converters, blowers, motors, pumps, generators, etc.

Ball Bearings

S K F INDUSTRIES, INC., Front St. and Erie Ave., Philadelphia, Pa. Bulletin describing the application of S K F ball bearings in fans and blowers. Types of fans, shaft diameters, and other data covering eighty-six actual change-overs from plain to ball bearings are given.

Drilling Machines

BUFFALO FORGE CO., Buffalo, N. Y. Bulletin 2989, illustrating and describing the Buffalo No. 22 drilling machine which is made in two styles—the round-column and pedestal types—with capacity up to 1 1/4-inch drills in steel. Complete specifications are given.

Swaging Machines

ETNA MACHINE CO., 3400 Maplewood Ave., Toledo, Ohio. Bulletin illustrating and describing the Etna Series 150 swaging machines, which have maximum capacity on tubing 1 1/2 inches in diameter and are built in die lengths of from 4 to 18 inches.

Nickel Cast Irons and Alloy Steels

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Bulletin containing a list of 136 manufacturers who exhibited products employing nickel alloy steels or nickel cast irons at the Machine Tool Show in Cleveland.

Welding in Construction Work

LINCOLN ELECTRIC CO., Cleveland, Ohio. Booklet entitled "Welding in Construction Work," illustrating and describing a number of unusual welding jobs, including pipe lines, structures subjected to internal pressure, ocean pier piling, and similar work.

Variable-Speed Transmissions

LENNEY MACHINE & MFG. CO., Warren, Ohio. Catalogue describing the construction and principle of operation of the new Lenney variable-speed transmissions, designed for use between prime movers and machines where a low variable speed is necessary.

Compressors

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Bulletins L-611-B4A and B5A, illustrating and describing Worthington steam- and motor-driven compressors of 11 and 13 inches stroke, and of 5, 7, and 9 inches stroke, respectively.

Cold-Drawn Steel

UNION DRAWN STEEL CO., Massillon, Ohio. Circular entitled "It's Easy to Understand How Union Cold Drawing Saves you Money," showing a variety of typical products that are produced economically from Union cold-drawn carbon and alloy steels.

Electric Contactors

ELECTRIC CONTROLLER & MFG. CO., Cleveland, Ohio. Folders 1140 and 1145, illustrating and describing the new EC & M Type LTZ "Line Arc" contactors for alternating-current service, and Type LT "Line Arc" contactors for direct-current service.

V-Belt Drives

T. B. WOOD'S SONS CO., Chambersburg, Pa. Catalogue 278, describing the advantages, applications, and installation of Wood's V-belt drives. Tables giving data that facilitate the selection of the proper drive for different conditions are included.

Helical Lead Measuring Machines

ILLINOIS TOOL WORKS, 2501 N. Keeler Ave., Chicago, Ill. Bulletin illustrating and describing the Illinois helical lead measuring machine No. 339 for determining the correctness of the helices of helical gears.

Zinc Alloys

APEX SMELTING CO., 2554 Fillmore St., Chicago, Ill. Chart No. 2 in a series known as "Metalgrams," showing the stability or dimensional change of No. 2 zinc-base die-cast alloy under different pressures and die temperatures.

Pipe and Tubing

REPUBLIC STEEL CORPORATION, Massillon, Ohio. Folder entitled "The Greatest Pipe Show on Earth," describing the various types of tubular products manufactured by this company and its subsidiary, Steel & Tubes, Inc.

Electric Motors

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio. Bulletins 118 and 119, illustrating and describing Type AA Reliance squirrel-cage induction motors of 1 to 25 horsepower and 25 to 150 horsepower, respectively.

Abrasive Cleaning Equipment

AMERICAN FOUNDRY EQUIPMENT CO., Mishawaka, Ind. Book No. 111, illustrating and describing the operation and construction of the American Wheelabrator Tum-Blast cleaner, an airless abrasive cleaning machine.

Corrosion-Resisting Steels

TIMKEN STEEL & TUBE CO., Canton, Ohio. Data Sheets containing complete technical data on Sicromo steel, a steel developed for applications where reasonable resistance to both corrosion and oxidation is required.

Paint

U. S. GUTTA PERCHA PAINT CO., Providence, R. I. Circular outlining the advantages of "Barreled Sunlight" paint for plant interiors and giving a list of manufacturers who have used this paint over a period of years.

Metal Hose

ATLANTIC METAL HOSE CO., INC., 123 W. 64th St., New York City. Folder illustrating the different types of flexible metal hose and tubing made by this concern. Brief descriptions and price lists are included.

Motor Brushes

OHIO CARBON CO., 12508 Berea Road, Lakewood, Ohio. Loose-leaf pocket-size catalogue containing complete data on the types of carbon brushes in most general use for industrial and other appliances.

Lathes

BOYE & EMMES MACHINE TOOL CO., Cincinnati, Ohio. Circular describing the construction and important features of the Boye & Emmes 16-inch geared-head lathe. Complete specifications are included.

Machine Tools

EASTERN MACHINERY CO., 3267 Spring Grove Ave., Cincinnati, Ohio. Machinery list No. 36, containing a complete list, with brief descriptions, of the rebuilt machine tools that this company has in stock.

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-2209, illustrating and describing General Electric bearing-temperature relays for protecting machine bearings against abnormal heating.

Electric Furnaces

HAROLD E. TRENT CO., 618-640 N. 54th St., Philadelphia, Pa. Leaflet TE-20, containing descriptive matter and specifications for the various sizes of Trent pot and trough type electric furnaces.

Indicating and Controlling Equipment

FOXBORO CO., Foxboro, Mass. Bulletin 202, illustrating and describing the complete line of Foxboro potentiometer and resistance thermometer controllers.

Floor Repair Material

FLEXROCK CO., 800 N. Delaware Ave., Philadelphia, Pa. Folder entitled "Ruggedwear Resurfacer," describing a method of making permanent repairs of industrial floors.

Expansion Bolts

RAWLPLUG CO., INC., 98 Lafayette St., New York City. Bulletin U-401, illustrating and describing the uses of the anchoring device known as "Rawl-Drive" for use in masonry.

Friction Materials

JOHNS-MANVILLE, 22 E. 40th St., New York City. Catalogue covering the J-M line of industrial friction materials in both flexible and rigid styles for clutches, brakes, etc.

Laboratory Equipment

BAUSCH & LOMB OPTICAL CO., Rochester, N. Y. Leaflet descriptive of the new Ortho-Stereo camera and Ortho-Stereoscope for laboratory research work and industrial use.

Indicating and Controlling Instruments

ESTERLINE-ANGUS CO., Indianapolis, Ind. Bulletin 735, descriptive of a new graphic meter for measuring and recording kilovolt-amperes.

Flexible Couplings

CHARLES BOND CO., 617 Arch St., Philadelphia, Pa. Circular F7 illustrating the most recently patented Bond flexible insulated coupling, known as the "Bondtru."

Machine Tools

INDUSTRIAL MACHINERY CO., 2100 Fletcher Ave., Indianapolis, Ind. List of metal-working and woodworking machines and electric motors offered for sale by this company.

Power Transmission Equipment

MORSE CHAIN CO., DIVISION OF BORG-WARNER CORPORATION, Ithaca, N. Y. Leaflets containing data on Morse "Morflex" couplings and Morse roller chain drive.

Set-Screws

BRISTOL CO., Waterbury, Conn. Bulletin 832, describing the construction and advantages of Bristo socket set-screws and socket-head cap-screws.

Flexible Shaft Equipment

DUMORE CO., Racine Wis. Circulars descriptive of the new Dumore No. 44 "Toolmaker" precision grinder, and the "Vari-Speed" flexible-shaft tool.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Ingersoll All-Electric Milling Machine

Milling, drilling, boring, and thread-cutting can all be performed at a single setting of the work on an open-side all-electric machine recently built by the Ingersoll Milling Machine Co., Rockford, Ill. This machine is equipped with an 8-inch cutter-bar and is one of the largest machines of its type ever constructed. The tool can work at any point within an area of 16 by 8 feet.

Particular thought was given in designing this machine to provide easy control and manipulation. Major adjustments and settings are obtained through the use of a very few levers, while minor adjustments are accomplished by means of the electric pendent control shown in Fig. 2. Much faster operating speeds are obtainable because of the finger-tip control feature. The operator does not need to predetermine the proper feeds and speeds; he can "feel" his way with five adjustments of the feed and speed variables until he obtains the maximum performance from the machine and tools.

The boring-bar can be advanced to within a few inches of the work without rotating, a feature that facilitates positioning the tool before the cut is started. Another important feature is that the speed of the bar can be increased or decreased by small increments while cutting is in progress. When used for milling, the machine can be made to jump into rapid traverse from a feeding cycle and to drop quickly back into the feed. These movements are obtained by merely pressing the proper buttons on the control pendent.

Another unusual feature is the use of tabular ways for the bed which provide a reservoir of oil above the sliding surfaces. The tubes are hardened and ground and are perforated with two series of holes at 1-foot intervals along their entire length. Oil admitted under pressure into the tubes at one point in the bed forces oil from the tubes on the

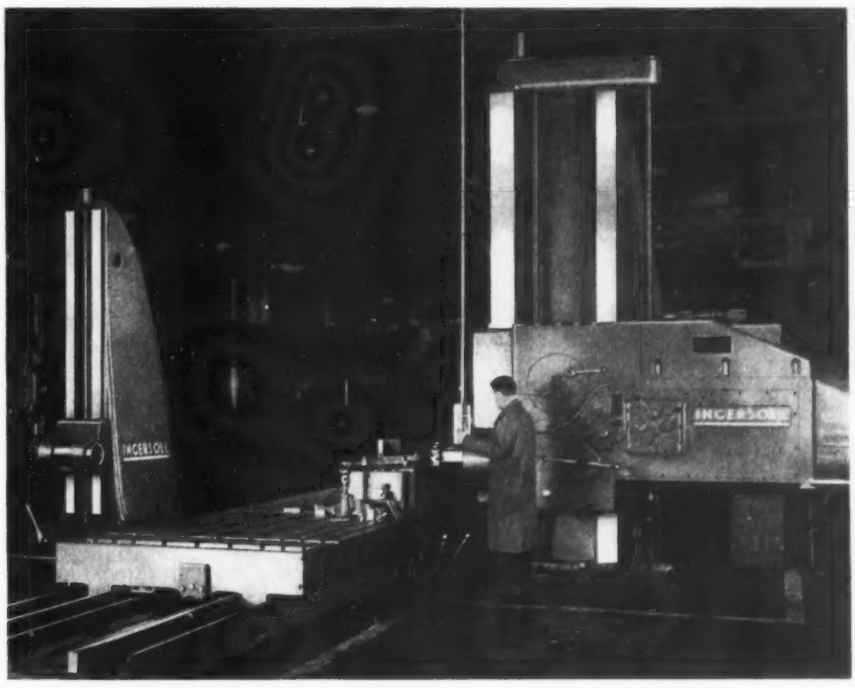


Fig. 1. An All-electric Ingersoll Machine which Mills, Drills, Bores, and Cuts Threads with a Single Setting of the Work

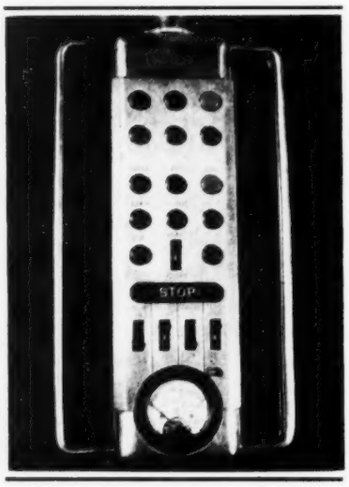


Fig. 2. Finger-tip Control of the Ingersoll All-electric Machine

ways to provide proper lubrication.

An offset way permits of locating the boring-bar as close to the way as possible and also allows the main drive gear to be located close to the spindle nose. The boring-bar is fed by means of a lead-screw located in the center of the bar. With this feeding method, no side thrusts are exerted on the bar, since the power is applied in a continuous straight line in the direction of the feed.

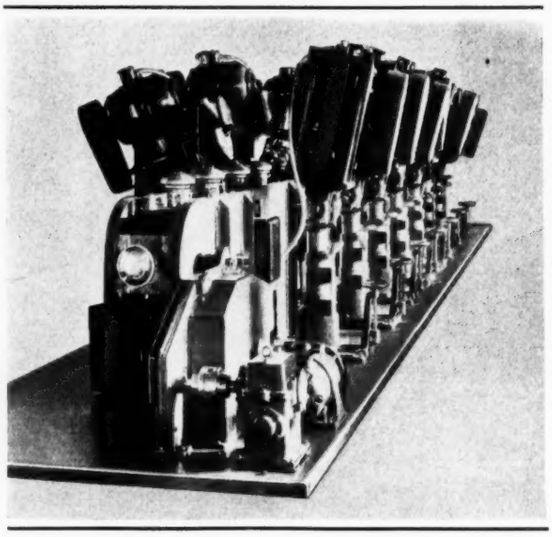
The table is driven in a manner that duplicates the action of a screw and nut without using either of these parts in their usual form. There is a one-third section of a nut extending the entire length of the table which is fastened to the under side. The conventional screw is replaced by a short worm. Helical gear teeth are cut integral with the worm, so that it functions both as a helical gear and as a worm. This allows the worm to be used as a driver and also as a driven member. The table can be run off the worm at both ends to provide maximum travel. The combined rating of the motors used on this machine is 50 horsepower. The shipping weight of the machine is approximately 128,000 pounds.

Packer Continuous Polishing and Buffing Machine

Fourteen wheel-heads are provided on a continuous type of polishing and buffing machine recently built by the Packer Machine Co., Meriden, Conn., in which the work is carried under the wheels by a chain conveyor. Thirty-eight work fixtures are attached to this conveyor, which is operated intermittently through the use of an indexing unit driven by a New Departure Transitorq variable-speed unit of three horsepower rating.

The work fixtures are equipped with ball-bearing spindles which can be run at various speeds, as they are driven by a second Transitorq of one horsepower rating. The work-spindles do not revolve at the loading and unloading stations.

Individual motors drive the wheel-heads through multiple V-belts, and these motors are individually controlled. Each wheel-head is equipped with an automatic composition feeding device. In addition to the type of work shown being polished and buffed in the illustration, this machine can be employed on flat surfaces. Also, the wheel-spindles can be arranged to oscillate automatically. The machine is 42 feet long and has a total weight of about 6 tons.

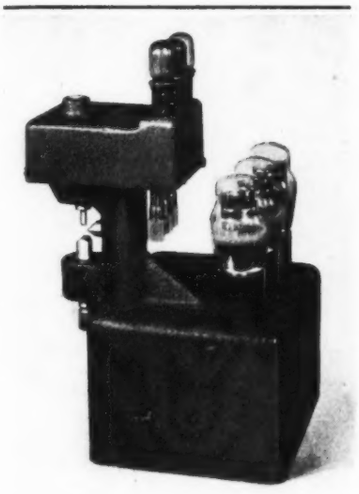


Packer Conveyor Type Polishing and Buffing Machine

Westinghouse High-Intensity Stroboglow

A portable low-priced Stroboglow, which produces a momentary illumination of 300,000 candlepower, is being introduced on the market by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This instrument is suited to the analysis of any periodic movement from 100 to 30,000 cycles a minute. With a maximum flashing speed of 5000 times a minute, it is possible to analyze motions up to 30,000 cycles a minute by flashing once every 2 revolutions for 10,000 cycles and once every 3 revolutions for 15,000 cycles.

The principal field of application for this instrument is in connection with the vibration analysis of rotating and reciprocating apparatus. However, it is also suitable for the sequence analysis of mechanisms that have motions of a recurrent nature, such as sewing machines, moving picture cameras and projectors, machine guns, etc. Objects can be made to appear at rest or to trace their prescribed course either forward or backward at any reduced speed. The Stroboglow can be used for measuring approximate rotational speeds, although it is not intended primarily for such applications.



Lights on this Gage Show Whether Work Meets Inspection Requirements

Inspectron Automatic Gage

Incandescent lights and vacuum tubes are used in combination on the Inspectron semi-automatic gage here shown, which is intended for inspecting parts up to and including 1 inch in size. This gage is a product of the Electronic Inspection Laboratories, 942 Prospect Ave., Cleveland, Ohio, and is especially suitable for checking cylindrical parts.

The work is inserted between the anvil and spindle on the left-hand side of the device, as shown, until it comes in contact with the back stop. If none of the lights on top of the device flash on, the piece is under size. If either the left-hand light or the middle light goes on, the piece is within the specified limits, but if the right-hand light goes on, the piece is over size.

Occasionally a standard is used to make sure that the gage is working properly. It is claimed that the gage can readily be set to check within 0.00001 inch. A dial indicator reading to 0.0001 inch can be applied to help in setting up the gage. Setting up is accomplished by inserting a standard between the anvil and the spindle and then adjusting the three micrometer heads on the back of the gage either by using the dial indicator or the micrometer graduations. There is an amplification of 10 to 1 in the gage.

This device can be used by plugging into any source of 110-volt alternating current of 50 or 60 cycles. It works on the same principle as the fully automatic gage manufactured by the same concern.

Youngstown Improved Safety Limit Stops

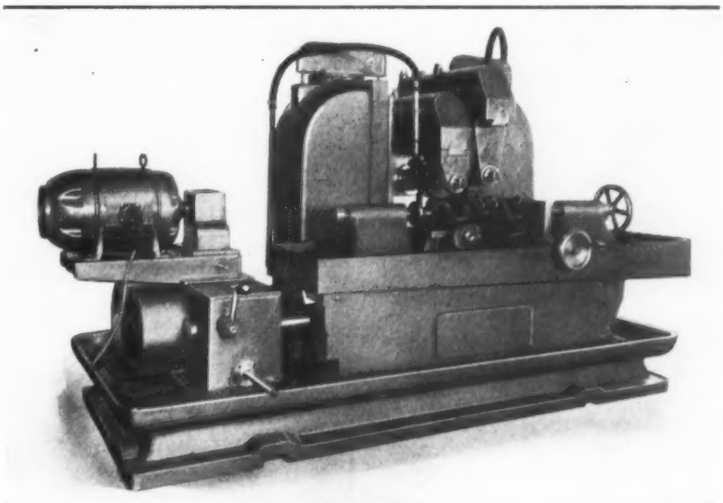
An improved safety limit stop intended to prevent over-hoisting accidents on overhead traveling cranes and applicable wherever a positive protection against over-travel is essential is being placed on the market by the Electric Controller & Mfg. Co., 2735 E. 79th St., Cleveland, Ohio. This limit stop handles motor currents directly without the aid of additional equipment. When the stop is tripped, it not only disconnects the motor from the power line, but also brings the motor to rest quickly with minimum drift.

Needle type roller bearings are used to provide almost frictionless operation, eliminate bearing wear, and permit infrequent lubrication. The cover of the device is made of heavier gage and is fitted with gaskets to make the unit splash- and dust-proof.

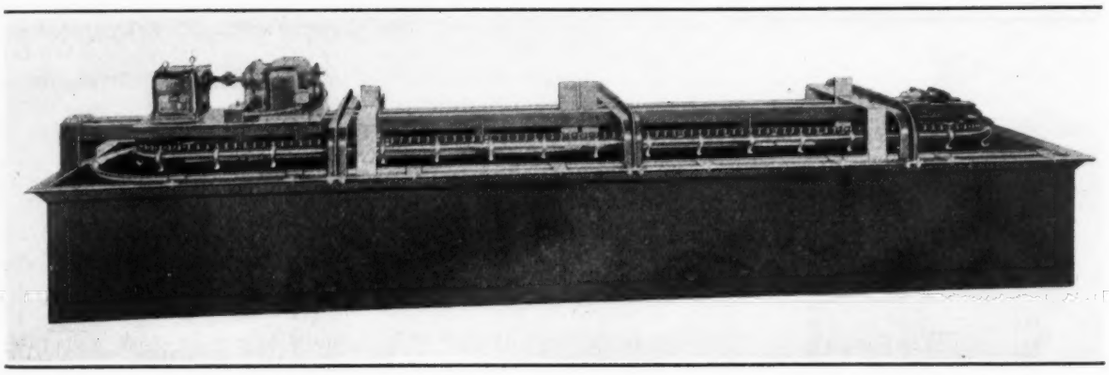
Producto-Matic Milling Machine for Automobile Crankshafts

A machine recently built by the Producto Machine Co., Bridgeport, Conn., for milling locating pads on automobile crankshafts preparatory to center turning their bearings in production lathes is shown in the accompanying illustration. The crankshaft is mounted between centers, an equalizing device being provided to support it and keep it properly aligned.

In the operation of this machine, the upper and lower cutter-spindle arbors have vertical movements, and the table has a horizontal movement. Both the cutter and table movements are controlled by cams. A simplified transmission with pick-off gears provides for changing feeds and speeds. The estimated production of this machine is from 60 to 65 crankshafts an hour.



Producto-Matic Arranged for Milling Locating Pads on Automobile Crankshafts



Semi-automatic Plating Machine Designed for Close Regulation of Quality and Low Plating Costs

Udylite Semi-Automatic Plating Machine

A semi-automatic plating machine which is said to give the advantages of better plating, closer production regulation, and lower costs has recently been developed by the Udylite Co., Detroit, Mich. When this equipment is used, each piece of work is subjected to identical plating conditions, such as plating time and current density. The machine can be set for plating work to various thicknesses.

Work racks are hung on a chain conveyor and carried around the machine at a definite rate of speed. Any desired chain speed between 1 and 4 feet a minute is obtainable. One man can load and unload the conveyor.

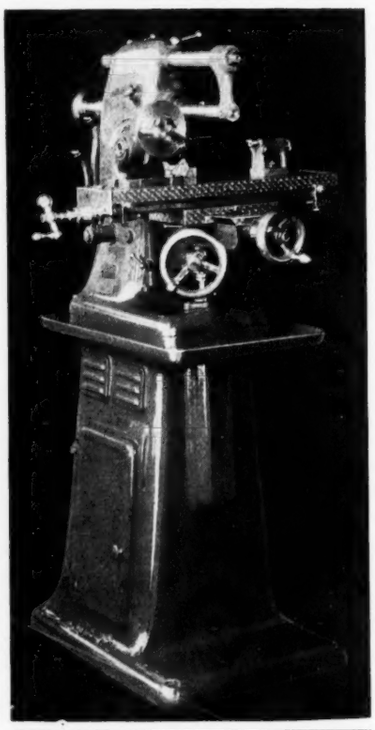
This semi-automatic machine can be built in a wide variety of sizes to suit individual plating problems. The machine shown is 18 feet long. The loading end is at the right.

Lathe Centers Tipped with Tungsten-Carbide

Tungsten-carbide tipped lathe centers have been produced in the past by the Tungsten Carbide Tool Co., Detroit, Mich., to special order only, but the demand for these centers has grown to such an extent that they are now being manufactured in routine production. The long life and minute wear of the tungsten-carbide tips enable accuracy to be maintained in finishing operations over long periods of time. In roughing operations, these centers are said to permit much heavier cuts than are obtainable with ordinary centers, since the amount of hogging possible is frequently limited by the ability of the centers to withstand heavy side thrusts without excessive wear.

Cataract Precision Milling Machine

A milling machine designed for high accuracy and easy operation to suit the needs of the tool-room and laboratory has recently been placed on the market by Hardinge Bros., Inc., Elmira, N. Y. Six spindle speeds from 120 to 1190 revolutions per minute are available in both forward and reverse directions. The feed-screws revolve in long adjustable nuts equipped with friction dials that are graduated to thousandths of an inch. Clutch throw-outs are provided on the handwheels for the transverse and vertical feeds.



Cataract Milling Machine Designed for Precision Work

The enclosed headstock is of a connected-bearing design. It is adapted to receive 1-inch capacity collets and is furnished with a ball-thrust draw-spindle. The table, knee, and saddle have positive locks and adjustable stops. The working surface of the table is 20 by 6 inches, and is provided with T-slots for attachments and fixtures. The knee is fully enclosed around the vertical feed-screw bevel gears, so as to exclude dirt and chips. A ball bearing absorbs the thrust on the vertical feed-screw.

Another feature of the machine is an enclosed belt drive with a lever speed control. A standard two-speed reversible motor is connected by an endless V-belt to a three-step pulley. The levers on the headstock operate two electrical motor controls. The motor is of 3/4 H.P. rating.

The machine can be supplied with such attachments as universal index-centers, a swivel vise, table power feed, and vertical attachment.

Hoover Ball Bearings

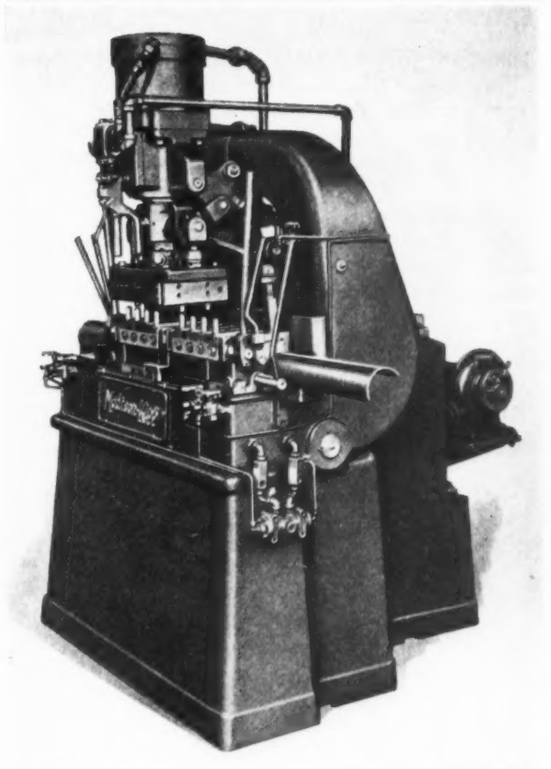
Seventy-five new sizes of radial and angular contact ball bearings have been added to the line of the Hoover Steel Ball Co., Ann Arbor, Mich. The additions include both single- and double-row types, all of which meet S. A. E. and United States Navy specifications as to design, tolerances, materials, etc. Special sizes and types of bearings have also been added to the Hoover line for specific applications in the automobile, truck, and tractor fields.

Single-row bearings are available in all sizes from No. 200 to No. 222 in the light series; from No. 301 to No. 318 in the medium series; and from No. 404 to No. 410 in the heavy series. Double-row bearings are available in all sizes from No. 5202 to No. 5210 in the light series and from No. 5302 to No. 5312 in the medium series. Both single- and double-row bearings can be supplied with one or two "Lubra-Seal" plates, as well as in the standard types.

Madison-Kipp Die-Casting Machine of Vertical Construction

A high-production machine of vertical design has been added to the line of die-casting machines built by the Madison-Kipp Corporation, 203 Waubesa St., Madison, Wis. This "Model 7 Vertical" is a special-purpose equipment intended for the pressure die-casting of lead or zinc alloys when parts require inserts of other metals or materials. It is particularly suited to the use of multiple-cavity dies.

As shown in the illustration, the machine has a traveling table, provided with two sets of multiple-cavity lower die-halves. The ram is fitted with one mating upper die-half. While castings are being made in the left-hand lower die, the right-hand lower die is open so that the operator is free to place in it a full set of inserts. Then when the ram is raised, the table indexes to bring the right-hand die into the casting position under the ram, and the left-hand die into the clear on the extreme left-hand end of the machine. While a new casting "shot" is being made in the right-hand die, the castings in the left-hand die are ejected and new inserts put in place, ready for the reverse cycle.



Madison-Kipp Die-casting Machine Designed for the Multiple Casting of Parts Requiring Inserts

The entire upper half of the machine rocks back automatically into contact with the metal pressure chamber or gooseneck at each downward stroke of the ram. On the upward stroke of the ram, this unit of the machine rocks forward clear of the gooseneck. Castings can be made only when the machine is locked in the casting position.

This equipment is fully pneumatic, the metal pressure chamber or gooseneck from which the metal is supplied to the die cavity, the ram for opening and closing the dies, and the traveling table all being air-operated. One or two men can control the machine from valves located on the opposite sides. Safety devices insure the proper cycle sequence when two men run the machine.

Cable or rod inserts may extend from the dies as far as necessary in front of the machine. As a matter of fact, castings have been made on inserts up to 5 feet long. The weight of this machine is approximately 5800 pounds. It has a length of 62 inches, a width of 60 inches, and a height of 74 inches. In handling lead, the metal pot capacity is 675 pounds, and the capacity of the gooseneck or metal pressure chamber is 13 pounds.

Goodrich V-Belts

A complete line of V-belts for both multiple and single drives is now manufactured by the B. F. Goodrich Co., Akron, Ohio. The multi V-belts are available in two styles. One style is of a single-strand construction especially designed to withstand flexing and

stretching on small-pulley, short-center, high-speed drives. For larger drives, there is a stronger belt of laminated construction, having a greater number of cords and several layers of stiffening fabric.

The "Longlife" V-belts for single drives have a cover that resists wear, a fabric filler which gives transverse strength without loss of flexibility, rubber - impregnated filler cords which resist stretch and provide longitudinal strength, and a compounded base which acts as a cushion and shock-absorbing member. Goodrich V-belts are made in machined molds to insure proper seating of the belts in the pulley and true running.

S K F Pillow Block Equipped with a Spherical Roller Bearing

SKF Pillow Blocks with Spherical Roller Bearings

The spherical roller bearing which has been provided by the S K F Industries, Inc., Front St. and Erie Ave., Philadelphia, Pa., for railroad journals, roll necks, crusher shafts, and other rotating parts of heavy-duty equipment, is now one of the features of an SA type pillow block being placed on the market by the concern. As shown in the illustration, the split construction makes possible a simple design with a small number of parts.

The spherical roller bearing is said to possess the ability of maintaining rolling self-alignment without imposing extraneous loads due to set-up inaccuracies or shaft deflections. The pillow block is designed with cross and transverse ribbing that insures strength with minimum weight. Felt sealing rings shield the bearings from dirt and other injurious matter. When the pillow blocks are to be used in applications where there is likely to be a great amount of dirt, flingers can be provided.

In installing one of these pillow blocks, the lower half is first set in place and bolted, after which the bearing is mounted on the shaft and properly located. The upper half of the pillow block is then simply bolted on. These pillow blocks are made in a wide range of sizes. They are available in either the free or held type.

When it is desirable to locate the shaft, a locating ring is applied between the face of the outer bearing race and the housing shoulder. This ring may be transferred from one housing to another or omitted when a free bearing is wanted.

Mitco Pin-Splice Turning Tools

The Michigan Tool Co., Detroit, Mich., is introducing a line of turning tools on the market under the name of Mitco Pin-Splice. The basic feature of these tools is the method for locating and clamping them in the tool-holder, which combines the advantages of the well-known dovetail and dowel methods. This type of mounting is claimed to give a longer tool life, eliminate breakage, simplify regrinding and set-ups, and reduce production costs. It also provides in a single tool cutting edges that formerly could only be obtained by the use of a number of separate tools.

From Fig. 1 it will be seen that the holder and tool are provided with small semicircular grooves which are parallel to a line tangent to the work piece at the point of tool contact. Dowel or splice pins are fitted into these grooves and fixed in the holder, so that the tool can

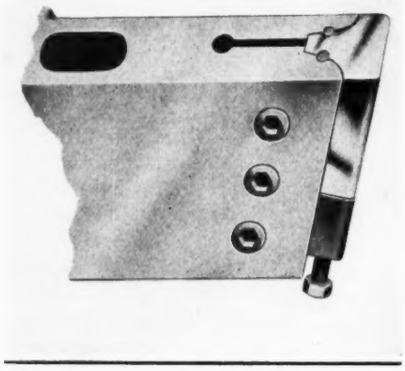


Fig. 1. Construction of Mitco Pin-Splice Tools

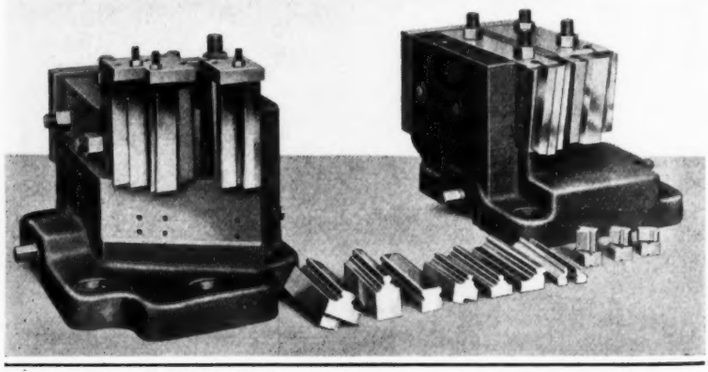
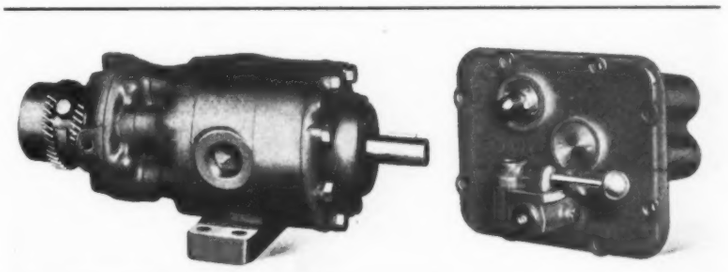


Fig. 2. Complete Pin-Splice Tooling Used on an Automatic Lathe for Machining Crankshafts

be shifted up and down in the holder to the desired position while using the pins as guides. The tool is locked in place by tightening clamps in the split holder.

Regrinding is simplified, since the tool is merely ground down to a new cutting edge and then moved up slightly in the holder in proportion to the amount of stock that was ground off. No angular adjustment is necessary. With this arrangement, the tools can be reground and used far beyond the point where tools of ordinary design have outlived their usefulness. The form of the tools is not changed throughout their life, and therefore regrinding would automatically restore the correct form if it were destroyed by accident. The unusual amount of support under the cutting edge of these tools is particularly advantageous in circular form turning.



Sundstrand Pump and Control Panel for the Hydraulic Operation of Machine Tools and Other Applications

Fig. 2 shows complete Pin-Splice tooling for an automatic lathe used for the rough- and finish-turning, cheeking, and forming of a crankshaft bearing and flange. The tool-block at the left is mounted on the rear of the lathe. The filler blocks seen in the right foreground are used when the tools have been worn down considerably in service.

Sundstrand Hydraulic Pump, Control Valve, and Circuit

Hydraulic equipment for machine tool feeds and other applications is being introduced on the market by the Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill. This equipment includes a pump, control valve, and circuit. The pumping unit actually consists of a variable-displacement pump which gives two adjustable feeds, and a constant-displacement pump which provides a rapid traverse. Both pumps are incorporated in a single housing and driven by one shaft, there being only two revolving parts in the entire mechanism. These parts are mounted in ball bearings.

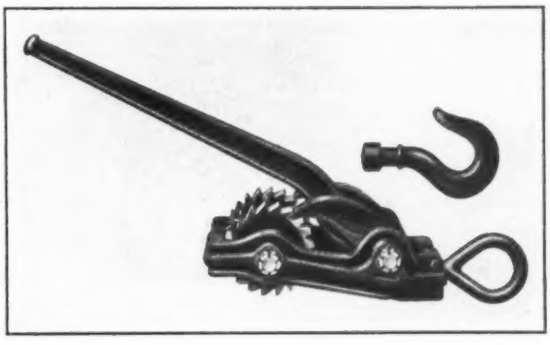
The variable-displacement pump is a new design of the multiple-piston type which gives a positive and uniform feed. The constant-displacement pump is of the Roto-Roll type in which a roller revolves in positive contact with a rotor or ring in the same manner as one of the rollers in a roller bearing revolves against the outer race. This provides a smooth rolling action and eliminates sliding blades and gears. Both pumps are built to high standards of precision, operate quietly, and are low in power consumption.

The control valve or panel, which is seen at the right in the illustration, provides a rapid approach, feed, adjustable dwell, and rapid return for machine members. A second or slower feed may also be obtained. The feed and rapid traverse sequence is controlled by adjustable dogs. A jump feed or rapid traverse between intermittent cuts may also be obtained by means of dogs. The control panel consists of a pilot and reversing and selector valves, all of which are operated from a low-pressure source. There is also a relief valve in the panel for both the high- and low-pressure circuits.

The Sundstrand hydraulic circuit is self-locking. It provides a smooth uniform feed and shockless high-speed traverses, and also prevents tools from jumping ahead upon the completion of a cut or during an intermittent cut. "Climb-cutting" can be performed satisfactorily on milling machines equipped with this circuit.

Acco Utility Jack

A jack suitable for a variety of applications involving stretching, pulling, binding, or lifting has been brought out by the Welded Chain Division of the American Chain Co., Inc., Bridgeport, Conn. This device is of simple construction and is suitable for loads up to 4000 pounds. It includes a frame with operating parts, a 10-foot stretcher chain, and a 5-foot anchor chain.



Jack Made by the American Chain Co. for a Wide Variety of Uses

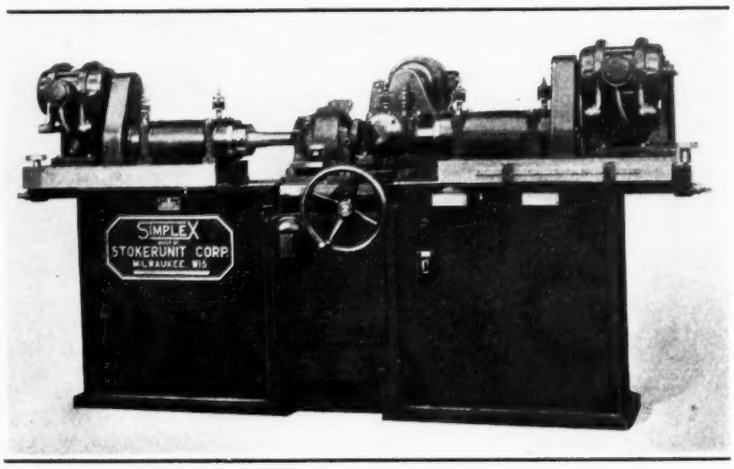
In use, the stretcher chain fits over the teeth

of a sprocket wheel and power is applied by raising and lowering a handle. The axle of the handle is eccentric, power being transmitted by two pawls and the sprocket wheel. One pawl is always in such a position that the wheel cannot slip.

Republic Oil-Resisting Pneumatic Hose

An air hose designed especially to overcome the deteriorating effects of hot oil from air compressors is being introduced on the market by the Republic Rubber Co., Youngstown, Ohio. This hose is made from a compound similar to that used in oil-conducting hose. It can actually be saturated with oil for long periods without its serviceability being affected.

In addition, the hose has unusual resistance to heat, high pressure, abrasion, the cutting effect of sharp rocks, and exposure to sun and weather. Unusual strength is said to have been obtained by constructing the plies from a twisted cord which is impregnated with a new rubber compound.



Simplex Precision Boring Machine of Three-way Construction

Simplex Precision Boring Machine of Unit Type

The Stokerunit Corporation, 5325 W. Rogers St., Milwaukee, Wis., recently developed a machine for the simultaneous precision boring of holes in different faces of a part. In this machine, the elements of a standard precision boring machine are merely rearranged to operate all at one time without loss of accuracy or flexibility of the set-up.

This machine has a heavy cast-iron bed which may be provided with either two or three sets of flat and vee ways. Each set of ways carries a platen on which one or more spindles may be mounted. Each spindle unit is equipped with an individual motor for driving a feed mechanism through pick-off gears. Normally, all of the spindles are fed at the same rate.

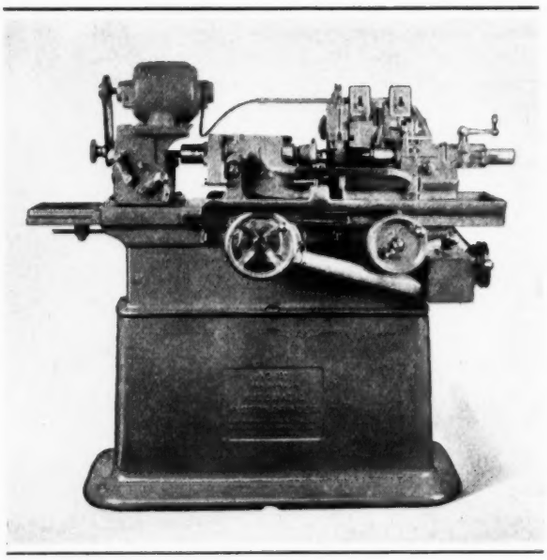
In operating this machine manually, the platens are brought to the work by turning the handwheel on the front of the bed. As the work is approached by the platens, a limit switch starts the spindles revolving and engages the feed. A second switch stops the

Van Norman High-Speed Piston Grinder

One of the most interesting exhibits at the Automotive Service Industries Show held recently in Atlantic City was an automatic piston turning and grinding machine shown by the Van Norman Machine Tool Co., Springfield, Mass. This No. 101 machine completely finished pistons at the Show at unusual speeds for this class of work.

Pistons of both the straight and cam type can be handled by this grinder. A shift of a lever is all that is required to convert the machine from straight grinding to cam grinding. The high rate of output is due not only to the use of increased spindle speeds and wheel feeds, but also to the simplicity of the machine and the ease with which it is operated. A number of wheel and work-head speeds are available.

All ways of the machine are hand-scraped and the bearings are of the anti-friction type. The bearings can be easily adjusted to compensate for any wear that may occur.

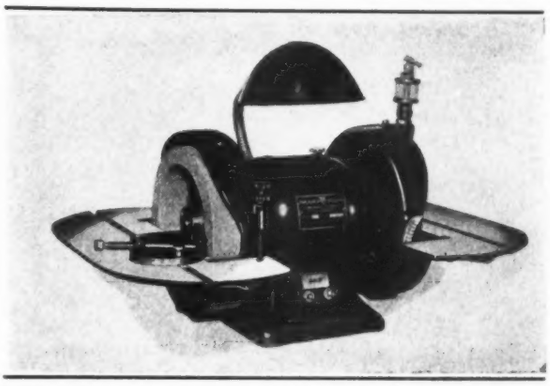


Van Norman Machine which Turns and Grinds Pistons at Unusual Speeds

feed at the end of the cuts. The platens are then returned to the starting position by means of the handwheel.

In an automatic cycle, an electrical control operates a traverse motor to advance the platens to the feeding positions and to return them after the cuts have been completed. Each platen is provided with an individual adjustment in relation to the work. Spindle speeds from 300 to 5000 revolutions per minute can be used to suit requirements.

This machine is intended for the precision boring of holes from 3/8 inch to 8 inches in diameter. The maximum feeding length is 12 inches. The distance from the top of the table to the center line of the spindles may be from 6 1/4 to 12 inches.



Prosser Widia Cemented-carbide Tool Grinder with Roughing and Finishing Wheels

Prosser Widia Cemented-Carbide Tool Grinder

Both rough- and finish-grinding of cemented-carbide tools can be performed on a Model AA grinder recently added to the line of Thomas Prosser & Son, 15 Gold St., New York City. This grinder is equipped with two quick-setting tables which are carefully planed and slotted to enable flat surfaces to be ground to accurate angles by means of cup-wheels.

Either a fine-grain silicon-carbide wheel or a diamond-impregnated grinding wheel can be provided for finishing. When a diamond wheel is to be used, an oil-feeding attachment is supplied to keep the face of the wheel well oiled while in use. This grinder can be supplied with other types of wheels for sharpening high-speed steel and other tools. The standard equipment includes a lamp, reversible motor and combination wheel-dresser, holder, and protractor. A pedestal can be supplied.

"Drip-Drop" and "Opto-Matic" Visible Lubricators

The Trico Fuse Mfg. Co., Milwaukee, Wis., has recently brought out a bottle type of oiler known as the "Drip-Drop," which is intended for use with solid, wick, or waste-packed bearings. This lubricator drops oil on the bearing from the top as the bearing needs it. The dripping is regulated by means of a Thermo-Dome within the cap.

The oiler eliminates daily oiling by the hand method. It is designed to suit practically all installations without requiring drilling or tapping. The oiler is made in three sizes, with capacities of 3/4, 1 1/8, and 1 1/2 ounces.

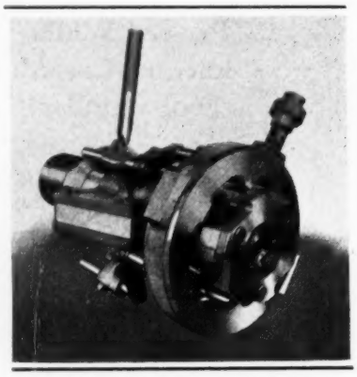
The same concern has also added a No. 3 size to its line of "Opto-Matic" constant-level lubricators described in February, 1933, MACHINERY, page 423. There are now three sizes of this oiler, with capacities of 4, 8, and 16 ounces. They are intended to maintain a constant level of oil on ring or ball-bearing shafts.

"Drip-Drop" Oiler which Lubricates as Oil is Required

Baldor 12-Inch Grinder

Bench and pedestal grinders equipped with 12- by 2-inch wheels have recently been added to the line of the Baldor Electric Co., 4351-63 Duncan Ave., St. Louis, Mo. These grinders are provided with a heavy-duty motor of either 2 or 3 horsepower, as specified. Exhaust type hinged guards are provided, as well as adjustable tool-rests which can be tilted for grinding to angles. The pedestal has an unusually wide base. Standard equipment includes a water pot, tool trays, and starter.

Baldor Grinder Built in Bench and Pedestal Styles



Collapsible Tap Equipped with a Trip-ring which Insures Ample Lubricant

Oil Type Trip-Ring for Landis Collapsible Taps

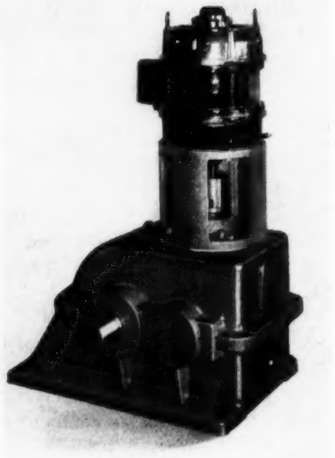
In tapping any threads, and particularly in tapping long threads of large diameter in steel, it is essential to maintain an ample supply of lubricant for dissipating heat and washing away the chips. To insure a sufficient supply of lubricant in using the collapsible taps made by the Landis Machine Co., Inc., Waynesboro, Pa., this concern has brought out an oiling type of trip-ring which is intended to replace the ring usually employed on a collapsible tap.

The illustration shows one of these rings applied to a 6-inch Style LM receding-chaser collapsible tap. The ring consists of a hollow housing with steel plates mounted on the front and back to form a reservoir for the lubricant. Holes are located diagonally in the housing through which a stream of oil is forced on each chaser during the entire cut to insure adequate lubrication at the points needed. For the smaller sizes of rings, the housing is made of cast iron, but for the larger rings, it is made of aluminum, so as to reduce the weight. The front ring, which contacts with the work in order to effect the receding and collapsible action of the tap, is made of steel and casehardened to resist wear.

Oil is delivered to the reservoir by a pipe which is fitted with a union connection for attaching a supply hose. When the tap revolves in cutting a thread, the housing of the trip-ring remains stationary, but the front and back plates turn with the tap. These rings are available for Styles LM receding-chaser and LT collapsible taps of 6 inches in size and larger.

D. O. James Speed Reducers

A speed reducer that consists of a combination of spiral bevel gears and continuous-tooth herringbone gears is being introduced on the market by the D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill. The motor is mounted vertically on top of the unit, as seen in the illustration, the arrangement giving a horizontal drive that occupies a minimum of floor space.



Reducer with Vertical Motor and Horizontal Output Shaft

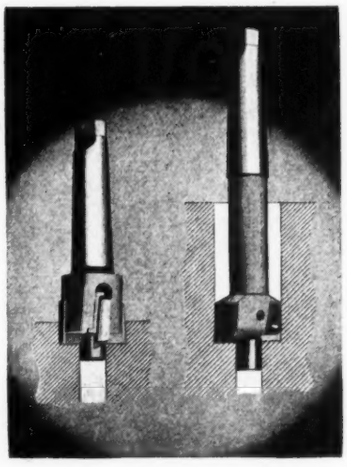
This type of speed reducer has been developed in a complete range from 1 to 200 horsepower. Ratios from 8 to 1 up to 45 to 1 and even higher are available. Timken bearings are provided throughout. All bearings and gears are lubricated by a force feed system which includes a plunger pump submerged in oil within the case.

Ingersoll Zee-Lock Counterbores

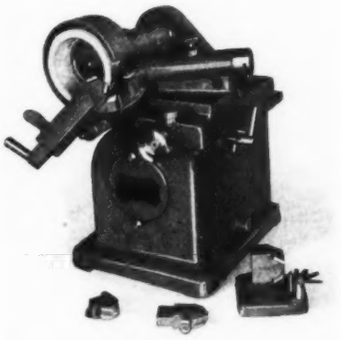
The Zee-Lock cutter blade recently developed by the Ingersoll Milling Machine Co., Rockford, Ill., has now been applied to inserted-blade counterbores. Two types of counterbores are being offered to the trade, one of which is designed especially for shallow boring or spot-facing operations, while the other is designed for deep boring.

The shallow counterbore has four serrated blades which interlock with a hardened and ground pilot. It is intended for boring when the depth of the counterbored hole is less than one-half the diameter. The deep counterbore has two heavy adjustable serrated blades. The body of this tool is relieved to provide a generous chip allowance, so that holes of great depth can be counterbored or previously drilled holes enlarged. The shallow counterbore is shown at the left in the illustration, and the deep-hole counterbore at the right.

The Zee-Lock cutter blade with which these tools are supplied is positively locked and is adjustable in two directions. Serrations are broached into the cutter housing, so that by moving the cutter blade to the next slot in sequence, the blade is moved out only part of a serration. Thus the diameter can be maintained with minimum grinding.



Zee-Lock Counterbores for Shallow and Deep Holes



Oliver Drill Grinder Equipped with a Jig

Oliver Drill Grinder with Jig for Small Drills

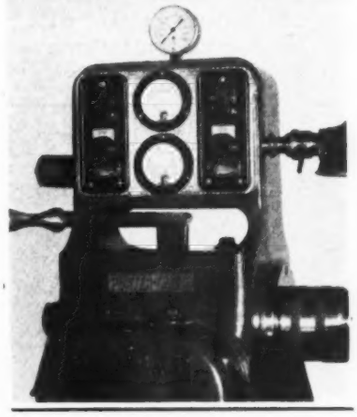
The hardest problem in grinding small drills is the difficulty of setting them properly in the machine. To provide for this, the Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich., has developed the No. 21 drill grinder here shown, which employs a jig to insure the proper setting of the drill. The drill can be accurately set in this jig at some place where the light is good and then transferred to the machine for grinding without further adjustment. One lip is ground after the jig has been placed in the holding fixture of the machine, and then the jig is reversed for grinding the second lip. Means are provided to insure that both lips will be ground to the same length.

Drills can be ground to various point angles from 80 to 180 degrees, and shoulder drills can be ground on the shoulder, as well as on the point. The rated capacity of the machine is for drills from 3/32 to 1/2 inch, but by means of a collet holder, drills up to No. 57 can be ground. The machine can be arranged for grinding left-hand drills and also the thick-web type of drills used for drilling oil-holes in crankshafts. Power is transmitted by V-belt from the 1/4-horsepower motor to the ball-bearing wheel-spindle. A carriage supports the fixture and a graduated arc.

Electric Head for Carbo-Lathes

A head that provides a central control for the entire electrical and hydraulic or air systems of Carbo-Lathes, built by the Porter-Cable Machine Co., Syracuse, N. Y., is here illustrated. This head is located at the left-hand end of either mechanical or hydraulic types of the machine, directly in front of the operator's line of vision.

The head includes starting and stopping buttons for all motors; pressure gages for either air or hydraulic systems; and direct-reading ammeters. The ammeters indicate the amount of power being consumed by the machine, and thus enable the operator to maintain proper feeds and speeds for obtaining the maximum efficiency of the machine and the proper condition of the cutting tools. The ammeters also warn the operator of any electrical trouble before it becomes serious, thus saving large repair bills.



Electric Head which Controls and Checks Carbo-Lathe Operations

In addition to the advantages mentioned, the electrical head provides the department supervisor with a means of checking an operation at a glance, thus preventing excessive tool breakage. This is especially a problem in departments operated on a piece-work or premium basis, as the operators in such departments are inclined to use tools until they break rather than take time to change them. An electric lamp extends from the head for illuminating the work and tools.

Link-Belt Worm-Gear Reducers

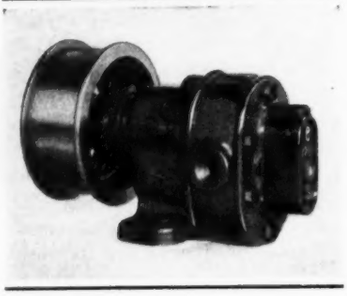
Cut-tooth worm-gear speed reducers that offer an unusual flexibility in the driving arrangement, as well as compactness and accessibility, are being introduced on the market by the Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa. These new speed reducers are available in a wide range of ratios and capacities with either a single or double reduction. Horizontal and vertical types are available, all types being provided with tapered roller bearings and lubricated automatically.

The output shaft can be located above or below the worm-shaft. The worm is a low-carbon alloy steel forging which is carburized and heat-treated after the worm threads have been cut. A feature of the double-reduction units is that the primary reduction unit is attached to the side of the final-reduction housing.

Conforming with the recommended practice of the American Gear Manufacturers' Association, the nameplate of each reducer is stamped to indicate the ratio,

Worm-gear Reducer of New Link-Belt Line

revolutions per minute of input and output shafts, the input horsepower or output torque capacity, and the service factor used in determining the rating of the unit.



B & S Pump which Operates at Motor Speeds

Brown & Sharpe Rotary Helical-Geared Pumps

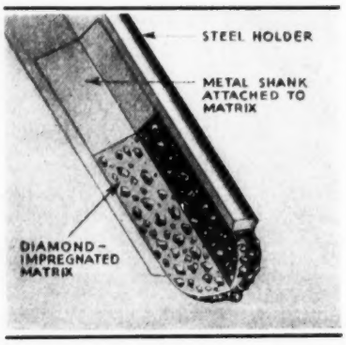
Rotary geared pumps provided with helical gears have recently been added to the line of the Brown & Sharpe Mfg. Co., Providence, R. I., in a new series known as Nos. 1S, 2S, and 3S. Owing to the smoothness and quietness of helical gear operation, the design permits these pumps to be operated at higher speeds than spur-geared pumps, thus enabling them to be driven direct at ordinary motor speeds. Renewable bronze bearings provide for easy replacement.

These pumps are intended primarily for use with comparatively clean liquids, and hence they are particularly suited for pumping clean oil, oil emulsion, soda solution, etc. They are especially advantageous for coolant installations when quietness is essential at motor speeds and when precautions are taken to protect the pumps from chips. They are also suitable for light hydraulic applications.

The pumps run in either direction, the discharge being on the side of the pump toward which the top of the pulley rotates. The pumps will raise oil on the suction side from 25 to 35 feet with tight piping and at speeds above 1000 revolutions per minute. When intended for pumping water, grease cups can be applied to the bearings to lengthen the pump life. A relief valve which acts as an emergency safety valve can also be supplied.

Diamond-Impregnated Wheel Dresser

A grinding wheel dresser impregnated with extra coarse diamonds has been added to the line of dressers manufactured by the Carboloy Co., Inc., 2987 E. Jefferson Ave., Detroit, Mich. The new dresser has been brought out especially for use on the larger and harder grades of grinding wheels employed on surface, cylindrical, and centerless



Carboloy Wheel Dresser with Extra Coarse Diamonds

grinding machines. This dresser supplements the previous Carboloy dressers, which contain diamonds of fine, medium, and coarse mesh.

Swivel-Fork Attachment for Baker-Raulang Trucks

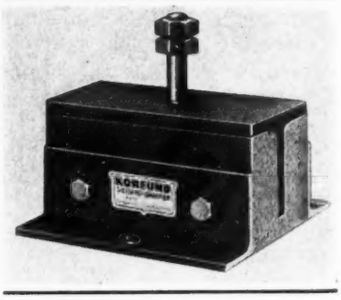
The Baker-Raulang Co., Cleveland, Ohio, has recently developed a swivel-fork attachment for the standard five-ton Hy-Lift trucks, one of which was described in September MACHINERY, page 29. This attachment provides greater flexibility for general material-handling in an industrial plant and for loading or unloading packaged sheet metal from railroad cars.

When packs of steel sheets are loaded crosswise in a car, the forks are slipped under a pack until it rests completely on the forks. The truck platform and forks are then raised to permit the pack of sheets to clear the trailing axles and truck under frame. Next the forks and their load are swung 90 degrees, so that the pack is held lengthwise of the truck. The steel sheets can now be carried conveniently out of the car door.

One man and a truck can handle steel sheets in bundles up to 3 tons in weight, 30 inches in width, and 96 inches in length. The fork attachment is quickly detachable, so that the truck can be readily adapted for general service.

Korfund Seismo-Damper for Isolating Vibrations

The Korfund Co., Inc., 48-15 32nd Place, Long Island City, N. Y., has recently designed a Type T Seismo-Damper for isolating the vibration of medium and light machinery. This damper is built in capacities of from 100 to 2500 pounds. It is so designed



Vibration Isolator of T-iron Design

that the machine is directly supported by a T-iron which, as shown in the illustration, is separated from a base constructed of two angle-irons by natural cork or other isolating material. The angle-irons are connected by bolts that pass through the

isolation materials and the T-iron but that do not touch the latter.

Before installation, the bolts are adjusted so as to produce a precompression of the isolating material to suit the machine load. Further adjustment can easily be made after installation. When a machine frame is light or must be supported at several points, the T-iron can be extended to form a continuous support between two or more dampers. Such an arrangement eliminates undue bending stresses in the machine frame.

Westinghouse Fan-Cooled Motor and Pump Motors

A totally enclosed fan-cooled direct-current motor with an external fan and shroud on the commutator end has been designed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The armature of this motor is as accessible as on straight totally enclosed motors. It is only necessary to remove one cover to have access to the brushes. An external blower can be used on the commutator end without having to remove two covers to examine the commutator.

A heavy shroud over the frame

Totally Enclosed Fan-cooled Direct-current Motor

provides a streamline appearance. While this shroud is integral with the frame, the pole bolts are accessible from the outside, so that it is not necessary to disturb the shroud in dismantling the motor.

The company also announces a line of motors intended especially for close-coupled pumps. These motors were developed in collaboration with a number of pump companies with a view to producing motors that would be standard for this service.

Bodine Worm-Gear Speed Reducer

Loads up to 1/4 horsepower can be carried continuously by a worm-gear speed reducer recently developed for use with the N-5 motors manufactured by the Bodine Electric Co., 2264 W. Ohio St., Chicago, Ill. Eight standard gear ratios from 8 to 1 up to 48 to 1 are available, and other ratios can be supplied to order.

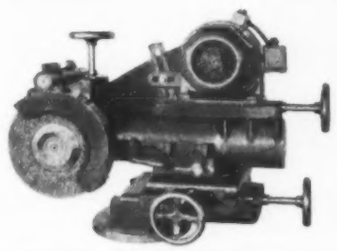
This speed reducer can be mounted in practically any posi-

Worm-gear Speed Reducer for Bodine Fractional-horsepower Motors

tion, with the motor or shaft horizontal or vertical, with the shaft parallel to or running through the mounting surface, and with the brackets turned for mounting on either a horizontal or a vertical surface. The shaft can be extended in either or both directions and a high-speed shaft can be brought out from the motor.

Hisey Portable Worm-Thread Grinder

Portable motor-driven equipment for grinding the threads of worms is being placed on the market by the Hisey-Wolf Machine Co., Cincinnati, Ohio, in one, three and five horsepower sizes. The unit consists of a grinding head that can be swiveled on a horizontal axis, so that the grinding wheel can be positioned at various angles in re-



Hisey Motor-driven Portable Worm-thread Grinder

lation to the work. The motor is adjustable along ways provided on this swiveling unit to permit increasing or decreasing the distance between the motor and the grinding wheel centers. The grinding head is mounted on slides which provide adjustments in two directions, and the entire unit can be swiveled around a vertical axis. The construction is such as to make the equipment completely universal.

A V-belt drive is provided from the motor to the grinding wheel. A wheel-dressing attachment can be furnished for truing bevel- or straight-face wheels mounted on either end of the grinding spindle.

Lincoln Electrode for 25-12 Stainless Steels

An arc-welding electrode intended for welding the 25-12 group of stainless steels is being announced to the trade by the Lincoln Electric Co., Cleveland, Ohio. Because of its high chromium content, this electrode is particularly advantageous for welding stainless-clad steels. It is known as "Stainweld B."

The weld metal obtained with this electrode has the same characteristics as steel containing 25 per cent chromium and 12 per cent nickel, possessing the same corrosion resistance, high tensile

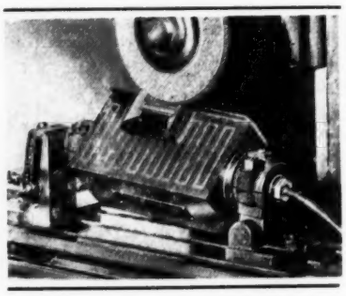
strength, and ductility. The weld metal is also unusually resistant to abrasion, and its various properties are maintained at high temperatures.

The electrode is heavily coated and utilizes the shielded arc principle for producing welds free from oxides, nitrides, brittleness, and porosity. Tensile strength tests have shown that "Stainweld B" weld metal resists a stress of 95,000 pounds per square inch. This electrode is available in 5/32- and 3/16-inch sizes and in 11-inch lengths.

Taft-Peirce Swiveling and Tilting Magnetic Chuck

A magnetic chuck that can be swiveled about its axis and also tilted from end to end is being placed on the market by the Taft-Peirce Mfg. Co., Woonsocket, R. I. This magnetic chuck is known as the "SuperPower Precision Duplex Base." Originally designed for grinding form tools, it also offers advantages in time-saving and increased accuracy in the grinding of work to compound or simple angles.

The magnetic unit of the chuck swivels to 90 degrees either side of the horizontal. It can also be tilted along its axis to any angle from 0 to 14 degrees. Two simple



Magnetic Chuck which can be Swiveled and Tilted

adjustments take the place of the complicated set-ups commonly required in grinding to compound angles. Accurately graduated scales facilitate angular settings and means are provided for clamping the chuck rigidly in the desired settings.

The magnetic unit is accurately ground on the top, bottom, and sides, and is designed on the Taft-Peirce all-steel principle.

Files with Increased Number of Cutting Edges per Square Inch

The Nicholson File Co., Providence, R. I., has developed a new method of file manufacture and a new tooth construction which are now being used in making the Nicholson, Black Diamond, and McCaffrey brands. The new manufacturing method and tooth construction make it possible to provide up to three times as many cutting edges per square inch as on previous files.

When the file teeth become worn down with use, reserve cutting edges come into action, thus prolonging the life of the files. Another advantage claimed for the new files is that they stay on the line of work without skidding or sliding to the right or left. Tests have shown that they possess unusual ability to remove stock whether used on brass, bronze, cast iron, machinery steel, or file steel.

The tooth construction and the method of manufacture are protected by patents pending.

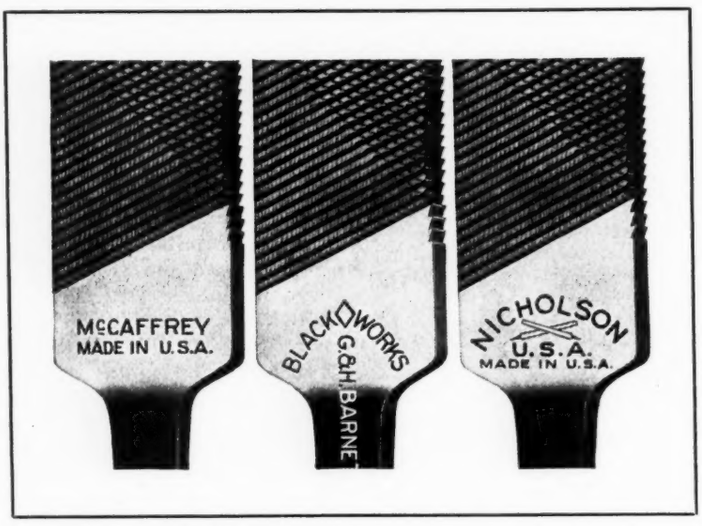
* * *

A New Use for the Electric Arc

An interesting application of the electric arc is mentioned by C. J. Holslag of the Electric Arc Cutting & Welding Co., Newark, N. J. Flat pulleys that give trouble by the belts slipping can be sufficiently "roughened" to grip the belt by using an arc-welding outfit. The electrode handle is rubbed against the pulley face, either without a welding rod in it or with welding rod, carbon, or graphite. The arc flashing will leave several thousand hard little "pimples" on the face of the pulley that will make the belt grip. The idea can also be applied to slippery steel gratings and floor treads.

* * *

A committee of the American Welding Society, 33 W. 39th St., New York City, has been appointed to correlate the requirements of existing codes relating to tests of qualifications of welding operators. The committee expects in the near future to submit the proposed procedure as a tentative set of rules for publication, at which time suggestions and criticisms will be invited.



Files Made by New Manufacturing Methods and with a New Tooth Construction

A New Rustproofing Development

The protection of metal surfaces against the destructive action of rust through the use of the oxide coating itself is a new development in the paint field announced by the Harrington Paint Co., Inc., 1630 Collamer Ave., East Cleveland, Ohio.

According to the company, the rusted surface, instead of requiring hours of labor for its removal, becomes an essential part of the coating, forming a film that is unusually resistant to the action of acids, alkalies, and weather conditions. This is accomplished by the use of a paint made with a chlorinated rubber base, which forms a non-inflammable and very tough film with great adhesive powers. The removal of the rust before applying the paint is not only unnecessary, but is actually undesirable. The weather improves rather than deteriorates the quality of the paint, as each fresh contact with weather or moisture is said to regenerate the protective elements of the coating.

* * *

Reducing Machine Vibrations

An effective means of eliminating or reducing noises caused by vibrating machinery has been devised by engineers of the Johns-Manville Corporation, New York City, through the use of ingenious vibration isolation platforms. These resilient machine mountings are designed to separate a mechanism from the rest of the structure in order to prevent the transmission of noise-producing vibrations. In the design of any vibration isolating construction, care must be taken to see that its natural frequency of vibration is well below the natural frequency of vibration of the machine itself.

To accomplish this purpose, vibration isolation platforms are made of two or more tiers of stringers, placed at right angles, and supported and separated from each other by vibration-absorbing "chairs." These "chairs" are U-shaped pieces of metal and felt which fit the stringers. A platform top is secured to the upper tier of stringers and the machine fastened to it. A loose rock wool "fill" occupies the space between the floor and the top of the platform, and is held in place by an apron or skirting.

The presence of heavy felt in the "chairs" lends the necessary resiliency to the platform. The "chair" spacing, with consequent variable loading, makes possible the design of platforms that will isolate practically any frequency of vibration in a highly satisfactory manner.

A typical example of the effectiveness of the construction is to be found in the Electrical Engineering Department of New York University where a 75-kilowatt motor-generator set, resting on a solid concrete foundation on the main floor of the building, set up a vibration which was felt to the far corners of the steel and concrete structure. It was impossible to adjust precision instruments or to line up other machines even a hundred feet away until the motor-generator was placed on an isolation platform. When this was done, the disturbance was immediately stopped and the installation termed a "complete success" by the head of the department.

* * *

Welding School Well Attended

Twenty-six engineers from eight states and two foreign countries concerned with the arc-welding of everything from plows to locomotives attended the December session of the one-week welding-engineering course offered each month jointly by John Huntington Polytechnic Institute and the Lincoln Electric Co., Cleveland, Ohio. This session brought together men of an unusually wide variety of interests. Included were representatives of machinery fabricators, railroad shops, oil refineries, structural fabricating shops, steel manufacturers, chemical plants, boiler and tank shops, pipe-line contractors, and job-welding shops.

One of the high-lights of the course was a demonstration of the use of polarized light for the study of stress concentrations in models of welded joints and machine parts.

The purpose of these courses, as outlined by A. F. Davis, vice-president of the Lincoln Electric Co., at a dinner meeting one night, is to help engineers to solve their welding problems. He cited specific examples of cost-cutting achievements made possible because of an engineer's firm conviction that there was a way to lower costs by welding, and because he stuck to the job of finding that way. To get the best results, one must often "design for welding."

Canadian Duties on Machinery Reduced

The import duty on almost all items of industrial machinery and farm equipment imported into Canada from the United States is reduced under the Trade Agreement recently concluded. More than half of the Canadian imports of industrial machinery from the United States now enters at a duty of 25 per cent instead of 35 per cent, as formerly. There is the further stipulation that if the machinery is of a kind not made in Canada, the duty will be only 20 per cent. The classifications affected by this reduction include air compressors, cement-making machines, ice and refrigerating machines, coal-handling machines, concrete mixers, cranes, derricks, and metal-working machinery.

* * *

Eighty-Ninth Birthday of Ambrose Swasey

On Thursday, December 19, Ambrose Swasey, chairman of the board of the Warner & Swasey Co., Cleveland, Ohio, celebrated the eighty-ninth anniversary of his birth. The occasion was marked by an informal luncheon at the works of the Warner & Swasey Co., in the building where the 82-inch McDonald telescope is being erected. A large number of Mr. Swasey's friends were present. The occasion was an evidence of the esteem and affection in which Mr. Swasey, the dean of the American machine tool industry, is held by all who have had the privilege of knowing him.

* * *

Air Filter Removes Oil Fumes in Sand-Blasting

Sand-blasting of the finer kind is often performed by an operator in a sand-blast room, wearing a gas mask and receiving his supply of air from a compressed air line. This method, however, is dangerous, since fumes are likely to occur in the air supply, due to overheated oil in the air compressor.

A Purolator air separator was recently devised by Motor Improvements, Inc., 365 Frelinghuysen Ave., Newark, N. J., for the purpose of absorbing such fumes and removing both oil and water moisture from compressed air lines, so that pure air is delivered to the operator.

Using Carbon Rods, Plates, and Paste to Facilitate Welding

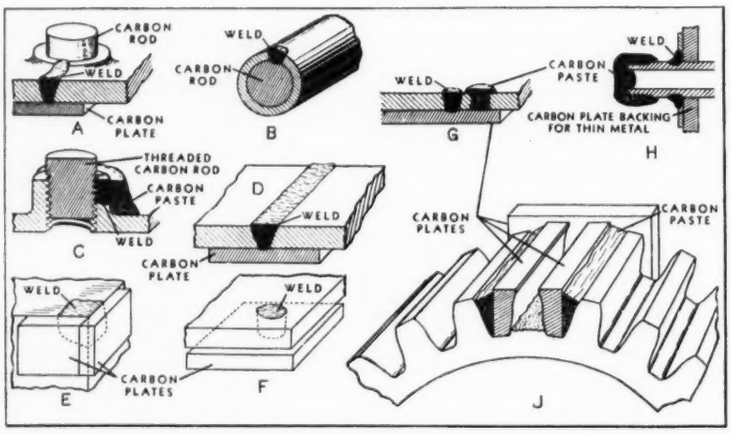
Gas or electric welding can often be greatly facilitated by the use of carbon rods, plates, and paste. Carbon in these different forms may be used as molds, cores, or dams to restrict the flow of molten metal and to protect adjacent parts against excessive heat. These carbon materials have proved especially useful in making vertical welds and in welding broken parts without removing them from their assemblies.

The illustration shows typical examples of the use of carbon rods, plates, and paste made by the National Carbon Co., Inc., Cleveland, Ohio. The carbon welding rods are made in various sizes up to 3 inches in diameter, and in 12- and 24-inch lengths.

The rod material is adapted for use as cores and fillers to save redrilling holes that might otherwise be filled with metal during the welding process. Added protection may be given a tapped hole by threading the carbon rod to fit. A threaded carbon rod can also be used as shown at *C* in the illustration for forming threads in the metal applied by welding to replace sections broken from the side of a boss having a tapped hole. Other uses of carbon rods are shown at *A* and *B*.

Carbon plates are used as backing-up material when welding thin plates or sections, as shown at *D*. In building up missing or broken parts with the electric arc or acetylene torch, carbon plates can be used to form a dam that will prevent the molten metal from flowing beyond the immediate weld, as indicated at *E* and *F*. Carbon plates placed under a weld leave a smooth welded surface and eliminate the necessity for subsequent machining or chipping. They are also useful in making forms for building up broken parts, such as the teeth on gears, as shown at *J*.

The carbon plates can be easily cut with a hacksaw to any desired size, and can be shaped into practically any form with a rasp or an abrasive wheel. They are mechanically strong, highly refractory, do not shrink, and will not easily burn, chip, or break, and under normal conditions can be used repeatedly.



Methods of Using Carbon Rods, Plates, and Paste in Making Repairs by Gas and Electric Welding

In building up metal around threaded or irregular shaped holes, or where it is necessary to use the arc or torch between or near machined surfaces, welding carbon paste used as a protective covering, as shown at *C*, *G*, *H*, and *J*, saves time and subsequent machining. Carbon paste is also an excellent medium for protecting gear teeth and other finished surfaces adjacent to the welded section. Thin aluminum sections or light parts can be backed up with paste to prevent collapse of the metal when it is heated.

* * *

Hydraulic control of both standard and special types of machine tools, especially milling, drilling, and grinding machines, may now be said to be almost standard practice. The rapidity with which the hydraulic idea is gaining ground is ample evidence of the advantages of this method of speed and feed control.

A By-Product of Acetylene Generators

The carbide residue in acetylene generators is a by-product that can be used as one of the principal ingredients in whitewash, fireproof cement, mortar, plaster, concrete, or stucco. Formulas and hints for the preparation and utilization of these products are given in a twenty-page booklet recently published by the Linde Air Products Co., 30 E. 42nd St., New York City, entitled "The Utility of Carbide Residue." The industrial uses of the residue as an oil and dirt scavenger, as a cleaner for drainage pipes, as a brake and clutch dressing for machinery, and as an ingredient in boiler lagging are described.

* * *

Air-Conditioning of Industrial Offices

Believing that better work and more healthful working conditions would result, the Keuffel & Esser Co., Hoboken, N. J., has air-conditioned a number of its offices, including the accounting department. This installation was made after a previous successful installation of air-conditioning in a process room in the plant which required the lowering of humidity in coating a special tracing cloth. The new installation uses Westinghouse cooling coils, heating coils, filters, and humidity sprays. The apparatus is all located on the floor above, with ducts leading to the conditioned offices below.

* * *

Government Requires Engineering Draftsmen

Applications for positions as chief engineering draftsman at $2600 a year and for a position as principal engineering draftsman at $2300 a year, for work on ships, are open with the United States Government. Applications should be filed with the United States Civil Service Commission, Washington, D. C., not later than January 6. Full information can be obtained from the Secretary of the United States Civil Service Board of Examiners at the post office or custom house in any city which has a post office of the first or the second class, or directly from the United States Civil Service Commission, Washington, D. C.

NEWS OF THE INDUSTRY

Alabama

CHARLES W. EAST, formerly of the Birmingham, Ala., office of the Republic Steel Corporation, Youngstown, Ohio, has been made assistant manager of sales in the pipe division of the company, succeeding GEORGE E. CLIFFORD who was recently appointed district sales manager in the Los Angeles, Calif., territory. ROBERT J. WORKING has been appointed district sales manager in the Birmingham, Ala., territory, succeeding KENNETH D. MANN, who has resigned to become executive vice-president of the Truscon Steel Co.

F. J. EVANS ENGINEERING Co., Birmingham, Ala., announces the opening of district offices at 1305 Watts Bldg., Birmingham, Ala., with F. J. EVANS in charge; 301 Red Rock Bldg., Atlanta, Ga., with G. J. KOLLOCK in charge; and 510 Fidelity Bank Bldg., Memphis, Tenn., with O. M. OLSEN in charge.

Illinois

BLISS & LAUGHLIN, INC., Harvey, Ill., manufacturers of cold-finished steel and shaftings, have just completed extensive plant improvements at the company's mill. An addition to the main building provides for increased floor space by extending the manufacturing bays and enlarging the shipping department and stock storage room.

PETER P. WAGENER, 1714 Walnut Ave., Wilmette, Ill., has been appointed representative of the Bignall & Keeler Machine Works, Edwardsville, Ill., in the Chicago and Middlewestern territory.

LINK-BELT Co., Chicago, Ill., has moved the executive offices of the company from 910 S. Michigan Ave., to the Bell Bldg., 307 N. Michigan Ave.

Michigan and Wisconsin

J. E. MACARTHUR has been made assistant general manager, in charge of national sales and service, of the Eclipse Counterbore Co., Detroit, Mich. Mr. MacArthur has had many years of experience, having held executive positions with such concerns as the Pierce Arrow Motor Corporation, General Motors of Canada, Ltd., and recently with the Kearney & Trecker Milling Machine Corporation, Milwaukee, Wis.

SHERROD E. SKINNER has been appointed general manager of the Ternstedt Mfg. Division of the General Motors Corporation, Detroit, Mich. This division produces the hardware and fittings for the Fisher body. Mr. Skinner has been connected with the company since 1930, and for the last two years has served in the capacity of assistant general manager.

EMERSON ELECTRIC MFG. Co., St. Louis, Mo., announces the opening of a branch sales office in the Stormfeltz-Loveley Building, Woodward and Grand Blvd., Detroit, Mich.

G. S. CRANE, sales manager of Cutler-Hammer, Inc., 12th and St. Paul Ave., Milwaukee, Wis., has been advanced to the position of vice-president in charge of sales. W. C. STEVENS, chief engineer, has been made vice-president in charge of engineering.

New England

RALPH E. FLANDERS, president of the Jones & Lamson Machine Co., Springfield, Vt., and past-president of the American Society of Mechanical Engineers, has been elected a director of the National Life Insurance Co. of Montpelier, Vt., for the unexpired term of Edwin B. Hamlin of Cleveland, Ohio, who recently died. Mr. Flanders is prominently identified with several of the machine tool companies of Springfield, Vt., and is not only a well-known engineer, but also an economist whose sound views have brought him distinction. He was a member of the Business Advisory and Planning Council of the United States Department of Commerce in 1933, and a member of the Industrial Advisory Board of the NRA, and the Advisory Board for Subsistence Homestead Administration.

WALTER L. TANN, hydraulic engineer of the Farrel-Birmingham Co., Inc., Ansonia, Conn., was the principal speaker at the December meeting of the Engineers Club held in Bridgeport, Conn., on December 5. Mr. Tann's subject was "Hydraulic Presses and Other Applications of Hydraulic Power." He traced the use of hydraulic power from earliest recorded history up to the application of hydraulic power in industry today, and also described the construction of presses used in the plastics and metal-working industries.

D. A. NEMSER, a past-president of the Hartford Chapter of the American Society for Metals, and New England representative of the International Nickel Co., Inc., with headquarters in Hartford, Conn., addressed the Rhode Island Chapter of the American Society for Metals at its meeting in December at Providence, R. I. Mr. Nemser's subject was the effects of alloying and heat-treatment upon the structure and properties of low-alloy constructional steels.

TRIPLEX MACHINE TOOL CORPORATION, 125 Barclay St., New York City, has opened a branch office at 20 Fern St., Auburndale, Boston, Mass., under the management of FRANK A. PARKER. Mr. Parker was connected for many years with the Jones & Lamson Machine Co., Springfield, Vt. RAY E. STERLING, previously connected with the National Automatic Tool Co., Richmond, Ind., has joined the sales office of the company, and is located at Meriden, Conn., P. O. Box 745.

L. S. STARRETT Co., Athol, Mass., recently acquired the business of the HENRY A. LOWE Co., of Cleveland, Ohio, manufacturer of the "Last Word" line of indicators. All the equipment for the manufacture of these instruments has been moved to the Starrett Works in Athol.

New York and New Jersey

A permanent exhibition of modern steel alloys selected from the products of twenty-seven American manufacturers was opened December 2 at the Metal Products Exhibits in the International Building, Rockefeller Center, New York City. This permanent exhibition includes metals, alloys, plastics, and metal finishes. The materials are shown in the form furnished to industrial users and their typical applications are also emphasized. Comprehensive data on physical and chemical properties are also available.

GABRIEL KRON, an engineer with the General Electric Co., Schenectady, N. Y., has been awarded the first prize of 10,000 Belgian francs in a competition sponsored by the George Montefiore Foundation of the University of Liege, Belgium, for the greatest contribution to the art and science of electrical engineering during the last three years. Mr. Kron's award was based on a paper entitled "Non-Riemannian Dynamics of Rotating Electrical Machinery."

SYDNEY BUCKLEY has been elected president of the Shepard Niles Crane & Hoist Corporation and will be located at the main offices of the company at Montour Falls, N. Y. Mr. Buckley was formerly vice-president and general manager of the Niles division at Philadelphia. HERBERT W. GLEDHILL, formerly manager of the Philadelphia district office, has been elected vice-president and general sales manager.

J. M. Highducheck, Midwestern Manager for American Cutting Alloys, Inc.

J. M. HIGHDUCHECK, formerly supervisor of cutting tools and applications of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed district manager in the midwestern territory for American Cutting Alloys, Inc., 347 Madison Ave., New York City, manufacturers of the metal Cutanit.

HOWARD KETCHAM, R.C.A. Bldg., New York City, color engineer, announces the organization of a design and research division for the purpose of conducting extensive surveys to predetermine style and color preferences in commercial products. During the last eight years Mr. Ketcham has been formulating color trends for various large concerns.

C. A. CHERRY has been appointed district sales manager for the Republic Steel Corporation, Youngstown, Ohio, in the Buffalo, N. Y., territory. Mr. Cherry replaces THOMAS B. DAVIES, who has been transferred to the alloy steel division in Massillon, Ohio, as special representative.

GEORGE R. WOODS, 17 Battery Place, New York City, has been appointed by the Ingenieursbureau "Lemet Chromium," Hilversum, Holland, American representative for the firm's chrome-hardening processes and patents.

THERMOID RUBBER CO., Trenton, N. J., announces the termination of the services of LLOYD LEAVER, vice-president in charge of sales of the mechanical rubber goods division. FRED MATHEIS, who has been connected with this department for many years, has been elected assistant vice-president and will continue to manage the office of the mechanical rubber goods division. S. H. LYONS, of the mechanical rubber goods sales division, has been appointed eastern manager of this department.

Pennsylvania and Ohio

O. R. WIKANDER, of the Edgewater Steel Co., Pittsburgh, Pa., was awarded the Melville Medal by the American Society of Mechanical Engineers at the annual meeting of the Society early in December. The award was made for Mr. Wikander's paper "Draft Gear Action in Long Trains." The medal, endowed by Rear Admiral George W. Melville, past-president of the Society, is awarded at intervals when a paper of exceptional merit is presented before the Society.

S. J. MIKINA, research engineer of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., received the Junior Award of the American Society of Mechanical Engineers at its annual meeting in the Engineering Societies Building, New York, for his paper, "The Effect of Skewing and Pole Spacing on Magnetic Noise in Electric Machinery."

C. G. CUNNINGHAM, formerly manager of the Pittsburgh office of the Pratt & Whitney Co., Hartford, Conn., has been made manager of the Chicago office at 564 W. Monroe St., Chicago, to fill the vacancy caused by the death of William Hunter. WILLIAM H. HULL will take Mr. Cunningham's place as manager of the Pittsburgh office. He was previously general manager of the eastern plant of the Expanded Metal Co. at Jeannette, Pa.

HARRY W. MCQUAID, of the Republic Steel Corporation, Youngstown, Ohio, addressed a meeting sponsored by the American Institute in the auditorium of the Metal Products Exhibits, Rockefeller Center, New York City, on December 13. His subject was "The Application of Steel Alloys, Present and Future."

M. L. ECKMAN, formerly research engineer of the Federal Machine & Welder Co., Warren, Ohio, who for a brief period acted in a research capacity for another manufacturer, has returned to fill the position of chief engineer with the Federal Machine & Welder Co.

* * *

The tax program which the government has devised to correct the manifest inequity in the present distribution of the nation's wealth cannot possibly do what the President hopes it will do. It must inevitably dissipate wealth rather than distribute it more equitably.—*Commerce and Finance.*

As part of a safety campaign, every man in the Fosdick Machine Tool Co.'s plant in Cincinnati is equipped with safety overalls having no buckles and no straps around the waist. The front of the overalls carries a label with the words "Safety First" and the name of the company.

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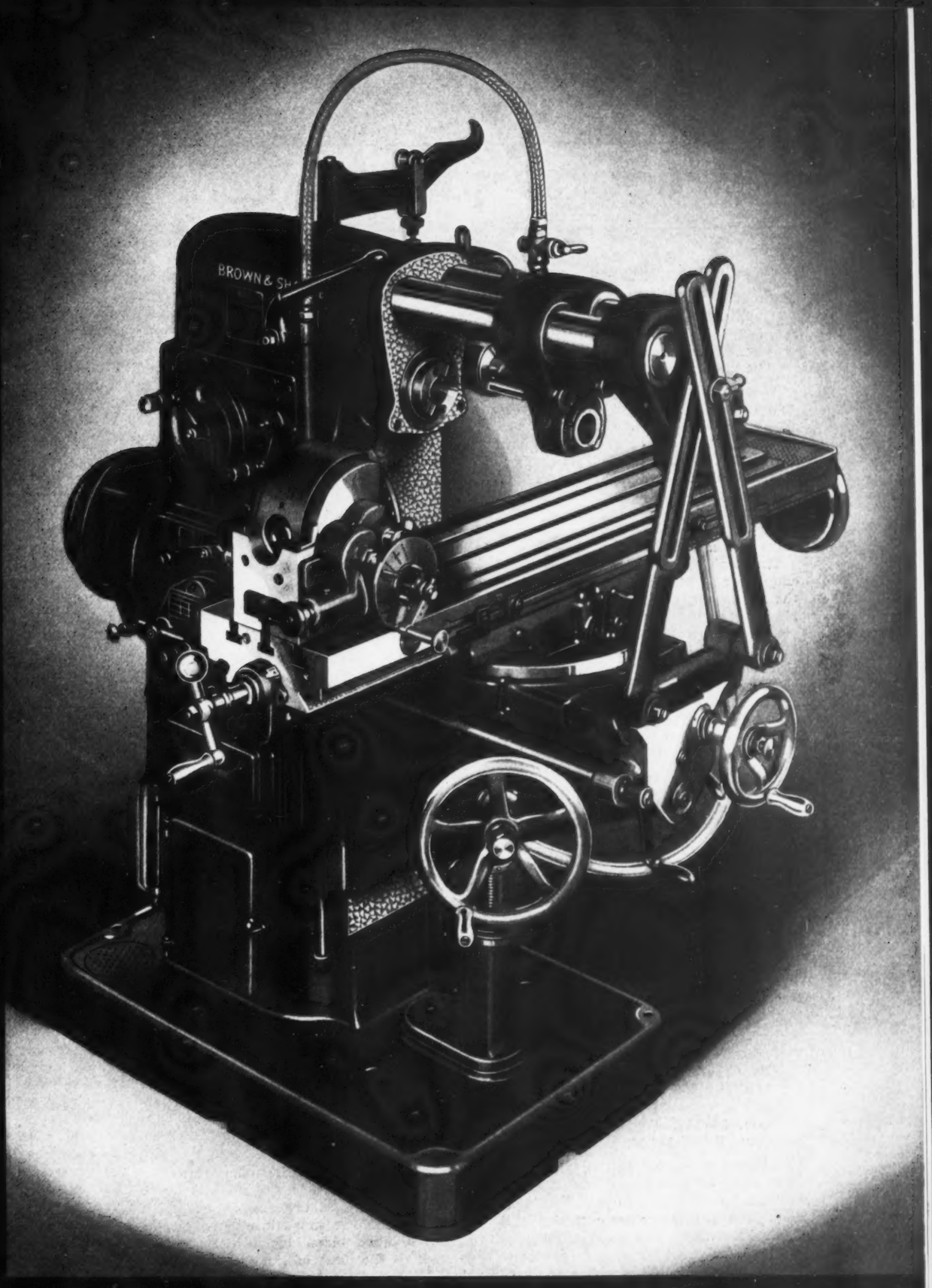

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NEW BOOKS AND PUBLICATIONS

FACTORY EQUIPMENT. By Joseph W. Roe and Charles W. Lytle. 517 pages, 5 1/4 by 8 1/4 inches. Published by the International Textbook Co., Scranton, Pa. Price, $4.

This book has been developed from the material collected over a period of years by the authors in their course on shop methods and equipment at New York University. It is intended primarily as a text-book for engineering students, presenting up-to-date material on new processes and equipment. At the end of each job there is a set of sample questions and a list of references.

The text is divided into twenty-five chapters and five appendices treating of the following subjects: Building and Manufacturing; The Drafting Department; Pattern Making and Woodworking; Smelting and Remelting; Metals Used in Industry; Foundry Molding; Hand and Power Forging; Die Forging and Casting; Pressing, Stamping, and Spinning; Welding, Soldering, and Brazing; Heat-Treating; The Tool-Room—Gages and Inspection; Tools for Cutting Metals; Turning: Engine Lathes; Turning: Turret and Automatic Lathes; Boring Mills and Boring Machines; Drilling; Planing, Shaping, Slotting, and Broaching; Milling; Gear-Cutting; Screw-Thread Cutting; Grinding; Selecting Equipment; Designing Jigs and Fixtures; Materials Handling; General Effects on Steel of Alloying Elements; Classification of Stainless Steels; Designation of Steel and Aluminum Alloys; General Information on the Feeds and Speeds for Various Cincinnati Milling Machines; Use of Inspection Trips as Supplement to Course.

THE CHEMISTRY OF SYNTHETIC RESINS. By Carleton Ellis. (Two volumes) 1419 pages, 6 by 9 inches. Published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York City. Price, $19.50.

This is the second edition of a comprehensive work on synthetic resins, the first edition of which appeared in 1923 under the title "Synthetic Resins and Their Plastics." The great number of synthetic resins and synthetic plastic products developed in the twelve years since the publication of the first edition, together with the recognition of a broader knowledge of the causes and nature of resinification, have led to a change in the title of the volume to "The Chemistry of Synthetic Resins." However, this does not mean that there has been any elimination of the sections on plastics and plastic molding. On the contrary, the treatment of this part of the subject has been considerably expanded.

The book deals very thoroughly with the chemistry of the various classes of resins. It describes the resinification process, gives chemical formulas, composition, properties, etc., of the thousands of different resins now available, and also describes the methods of production, and molding, and the fields of application. One of the valuable features of the book is a complete list of trade names of the various synthetic resins and plastic products, including composition, name and address of manufacturer, and uses.

MECHANICAL CATALOGUE (1935-1936). 338 pages, 8 3/4 by 11 1/2 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

This is the twenty-fifth annual edition of a collection of mechanical engineering catalogue material covering industrial equipment, materials, and supplies. The present volume contains 1500 items, compared with 1200 last year, and there are 700 firms listed, compared with 665 in the previous edition. The book contains, in addition to the catalogue data, a classified index to manufacturers, listed under 4000 classifications of equipment. A new feature of the present volume is a manufacturers' list containing the names of the firms included in this volume arranged alphabetically, together with their addresses and products.

This book should be an important aid to those who buy or make specifications for industry, as well as to engineers who have to make preliminary plans and lay-outs.

MATERIALS TESTING. By Irving H. Cowdrey and Ralph G. Adams. 144 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $1.75.

This is the second edition of a work on the theory and practice of materials testing. The present edition has been revised to include new developments that have taken place during the ten years since the first edition was published. The writers have attempted to include only those improvements and developments that have been tried and proved worthy of acceptance as standard.

Among the instruments described are the Huggenberger tensometer; the Vickers and Monotron hardness testers; and the Morehouse proving ring. New material on the use of the Rockwell hardness tester is included and a new chapter has been added on concrete testing.

PRESS WORK PRESSURES. By C. W. Lucas. 128 pages, 8 1/4 by 10 3/4 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $4.

This book has been written, according to the foreword, to guide the mechanical engineer in estimating the size of press required for a given job. The information has been accumulated over a period of twenty years and is based on more than 1000 tests classified according to the operation, material, shape and size of the piece, so that ready comparison of the work in hand can be made. The material is grouped according to the following operations: Coining; Drawing; Embossing; Forging; Forming; Hook Seaming and Curling; Punching, Shearing, Hollow Cutting, and Sprue Cutting; and Riveting.

PRACTICAL SHOP MATHEMATICS (Volume I). By John H. Wolfe and Everett R. Phelps. 331 pages, 5 by 8 inches. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York City. Price, $2.20.

This is the first volume of a work on shop mathematics which will be published in two parts, Part I dealing with elementary mathematics, and Part II with more advanced work, as applied to shop problems. The text is based on a course in shop mathematics taught by one of the authors, Mr. Wolfe, at the Ford Apprentice School, the work being intended particularly for use in trade schools, vocational high schools, and regular high schools.

GRAPHIC COURSE OF PATENTABLE INVENTIONS. By H. A. Toulmin, Jr. 40 pages, 6 by 9 inches. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City. Price, $1.

The purpose of this book, according to the foreword, is to furnish a simple, graphic, and clear exposition of each of the major steps in the life of an invention, which include the development of an invention from an idea into a tested and completed apparatus or process; the protection of the invention by a patent; and the enforcement of the patent in the courts.

THE EFFECT OF RESIDUAL LONGITUDINAL STRESSES UPON THE LOAD-CARRYING CAPACITY OF STEEL COLUMNS. By Wilbur M. Wilson and Rex L. Brown. 28 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 280 of the Engineering Experiment Station. Price, 30 cents.

PREDICTING THE STRENGTH OF STRUCTURES FROM TESTS OF PLASTER MODELS. By Raymond J. Roark and Richard S. Hartenberg. 50 pages, 6 by 9 inches. Published by the University of Wisconsin, Madison, Wis., as Bulletin No. 81 of the Engineering Experiment Station.